APPENDIX N

SURFING STUDY

SAN ELIJO LAGOON

RESTORATION PROJECT

SURFING STUDY

Prepared for:

THE SAN ELIJO LAGOON CONSERVANCY

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1. INTRODUCTION

The study was commissioned by the San Elijo Lagoon Conservancy (SELC) to attempt to quantify the potential surfing impacts that may result from the San Elijo Lagoon Restoration Project (SELRP or Project). Three alternatives, described in Section 3.0, are being considered for the Project and each were identified as having the potential to impact surfing through:

1. Increasing tidal flows through the existing tidal inlet (Alternatives 1A and 1B);
2. The possible creation of a modified or relocated tidal inlet (Alternative 2A), and
3. The deposition of export sand generated from the Project on the beach or in the nearshore waters of the adjacent Cardiff State Beach (Alternatives 1B and 2A).

The San Elijo Lagoon (Lagoon) is located approximately 20 miles north of the City of San Diego, between the Cities of Solana Beach and Encinitas, as shown in Figure 1-1. The California Department of Fish and Game generally owns the San Elijo Lagoon west of Interstate 5 (I-5), the County of San Diego generally owns the Lagoon east of I-5, and the SELC owns smaller areas west of I-5. The SELRP area boundary is illustrated in Figure 1-2.

The Lagoon is a coastal wetland with significant biological and ecological resources. The SELRP is an effort to restore the Lagoon functions and values given the constraints placed on it by surrounding current and historic development activities. The Project aims to enhance the tidal prism of the Lagoon by proposing modifications to known infrastructure “choke points” such as Highway 101, the North County Transit District (NCTD) railroad, and the I-5 freeway. The approximate target construction start date of the SELRP is the year 2015.

The overarching goal of the SELRP is to protect, restore, and then maintain, via adaptive management, the Lagoon ecosystem and the adjacent uplands to perpetuate native flora and fauna characteristics of Southern California, as well as to restore, then maintain estuarine and brackish marsh hydrology (EDAW 2009). A clear challenge of this Project is a design that will protect and promote biodiversity by protecting habitat types over a very long period of time.

The Project goal can be further refined into three categories of objectives:

- Physical restoration of Lagoon estuarine hydrologic functions;
- Biological restoration of habitat and species within the Lagoon; and
- Management and maintenance to ensure long-term viability of the restoration efforts.

Figure 1-1: Project Vicinity Map
(Source: EDAW/AECOM 2008)

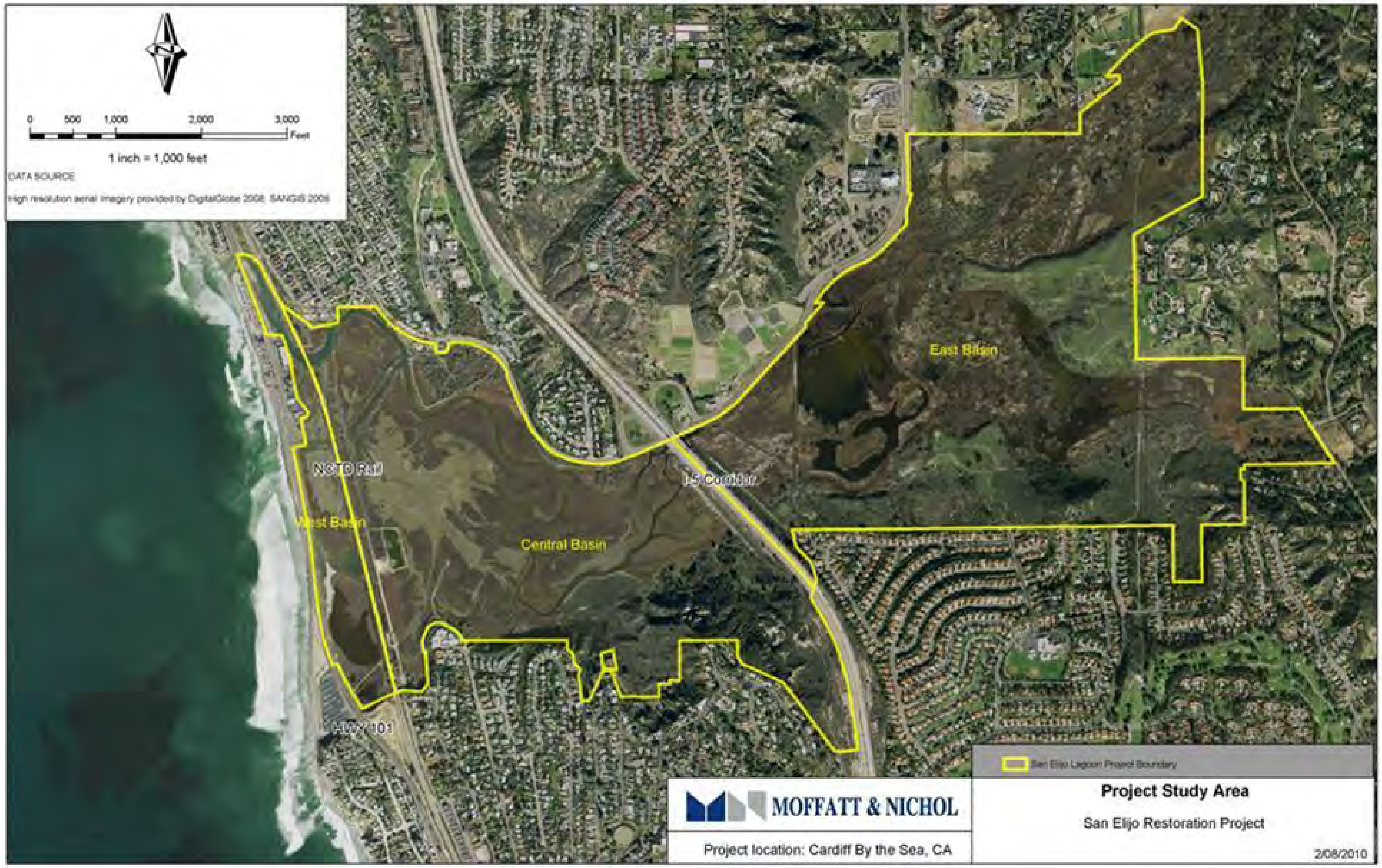


Figure 1-2: Project Study Area

The Surfing Study area extends from the Batiquitos Lagoon mouth to Torrey Pines State Beach, a length of approximately 16 miles. The study area bounds were determined considering the surfing resources with the highest likelihood to be affected by the Project.

This study presents results of analyses of potential Project effects on surfing. Results are compared to existing conditions, as determined by an existing conditions study for a 6-month period. The study was a bi-weekly surfing-monitoring program to establish an objective baseline condition of the study area. This baseline condition data were used to:

1. Determine where the most valuable (highest utilized) surfing resources are in the study area; and

2. Establish a baseline data set for later comparisons with post-Project conditions at these same locations.

2. DEFINITIONS

The terms listed below are commonly used in the sport of surfing to qualitatively describe wave conditions and were used in this study for the same purpose. Definitions are provided to facilitate understanding by a general audience.

- **Backwash**: Waves generated from the reflection of incoming wave energy off of a fixed feature (e.g., bluff or seawall) or a steep beach face that result in waves that propagate in the seaward direction.
- **Channel**: Refers to specific areas at a surf spot where deeper water exists, which prohibits wave from breaking. Allows for easy access into the line-up.
- **Fast**: A wave that peels quickly either to the left or right when viewed from shore. This results when a wave crest is typically approaching the shore at an angle close to shore-parallel. Can be a negative connotation if referred to as "too fast."
- **High tide**: Considered to be tides greater than three feet in height.
- **Hollow**: Plunging breakers caused as a result of the ocean floor having a steep slope or sudden depth change seaward of the break. The crest of the wave will become vertical and then curl over and drop to the trough of the wave. Generally preferable to shortboarders.
- **Line-up**: Where the majority of surfers sit to wait for waves to ride. Located seaward of breaking waves. Also known as the take-off zone.
- **Longboard**: Larger and more buoyant surfboards that are more conducive to riding smaller and lower power waves than shortboards. However, are ridden in all conditions and are popular at many of the breaks in the study areas due to the length of rides.
- **Low tide**: Considered to be tides less than three feet in height.
- **Mushy**: Spilling breakers that are generally a result of a gradual slope of the ocean floor seaward of the break. The wave will gradually steepen as the wave approaches the shore until the crest becomes unstable and whitewater spills down the face of the wave. Generally preferable to longboarders.
- **Peak(or Peaky)**: Refers to waves that break from a particular high point along the wave crest toward adjacent "shoulders," either to the left or right of the peak when viewed from shore. Peaks break in sections; as opposed to the wave crest breaking all at the same time with no peel. Generally a result of non-contiguous sandbars, wave refraction, or a combination of swells.
- **Peel (or Peel Angle)**: A wave breaking at an angle to shore with crest spilling or plunging in a constant direction, either to the left or right when viewed from shore.
- S**ection (or Sectiony)**: A wave that does not peel evenly, but experiences a portion of the wave crest breaking out of place in front of the rider, thus interrupting the

ride and potentially "closing out" the wave (rendering it unrideable any farther from that point).

- **Shadow(ed)**: Refers to an area that receives less swell (smaller wave heights) during a particular swell direction. Can be due to refraction, reflection or shoaling properties of the break or in areas in the immediate vicinity.
- **Shortboard**: Specific to a type of surfboard that is designed for higher performance surfing. The boards have a much lower overall volume than longboards and the decrease in buoyancy requires a different style of surfing and preference of waves. Generally ridden by more experienced surfers and typically prefer plunging or fast spilling breakers.
- **Shoulder(s)**: The areas to either side of the "peak"that constitute a more gently sloping portion of the wave where it is not yet breaking.
- **Slow**: A wave that peels slowly either to the left or right when viewed from shore. This is typically a mushy, spilling breaker. Wave generally allows for long rides and multiple maneuvers; however, is generally considered an unexciting ride by more experienced surfers.

3. SCOPE OF WORK

The scope of work for this Surfing Study includes the following tasks:

1. Describe the proposed project (i.e., proposed alternatives with any modifications to the tidal inlet location and configuration);
2. Characterize the existing physical environment;
3. Evaluate the proposed project impacts on surfing;
4. Identify recommendations for resource protection and project optimization; and
5. Prepare draft and final reports.

This report constitutes Task 5 in the form of the draft report.

4. PROJECT DESCRIPTION

Three proposed Project restoration action alternatives have been identified by the San Elijo Lagoon Conservancy (SELC) and the Stakeholder Committee of public and resource agencies as candidates for consideration. A fourth alternative of no action is also being considered, and will be included in the environmental document. The alternatives to move forward for evaluation include:

- No Project – Existing Conditions;
- Alternative 1A – Minimum Changes;
- Alternative 1B – Maximum Habitat Diversity, Existing Inlet Location; and
- Alternative 2A – Maximum Habitat Diversity, New Inlet Location.

The conceptual design of these alternatives is required to perform engineering analyses and numerical modeling of their performance. Brief descriptions of the alternatives are provided below, and habitat graphics of all alternatives are provided in this section. Detailed descriptions of the alternatives are provided in the Final Alternatives Assessment Report (Nordby et al. 2012).

4.1 NO PROJECT – EXISTING CONDITIONS

No Project assumes no changes are made to the Project site and existing conditions remain into perpetuity. The Lagoon presently experiences mouth constriction and manual re-opening annually, and sometimes more frequently. Tidal flushing is restricted and water quality conditions are impaired for nutrients and sediment. Habitat is distributed at elevations and locations that are related to relic, closed-mouth conditions, and are progressively transitioning to distributions more reflective of managed-mouth conditions. For example, mudflat habitat is located too high for a full tidal lagoon because it formed when the mouth was closed and Lagoon water levels were higher from impoundment. Now that the mouth is managed to remain open, the mudflat is converting to vegetated marsh because hydrologic conditions are favorable for salt marsh plant growth. Figure 4-1 shows existing conditions.

4.2 ALTERNATIVE 1A – MINIMUM CHANGES

Alternative 1A provides minimal physical changes to the site, with the exception of enlarging the main feeder channel throughout the site and redirecting its course just west of I-5. The main tidal channel is also extended farther into the East Basin and existing constricted channel connections are cleared and enlarged. Existing habitat areas will essentially remain intact. The tidal prism of Alternative 1A will be slightly increased compared to existing conditions. A relatively small area of transitional habitat above tidal elevations will be placed in the northwest portion of the Central Basin. Figure 4-2 shows Alternative 1A.

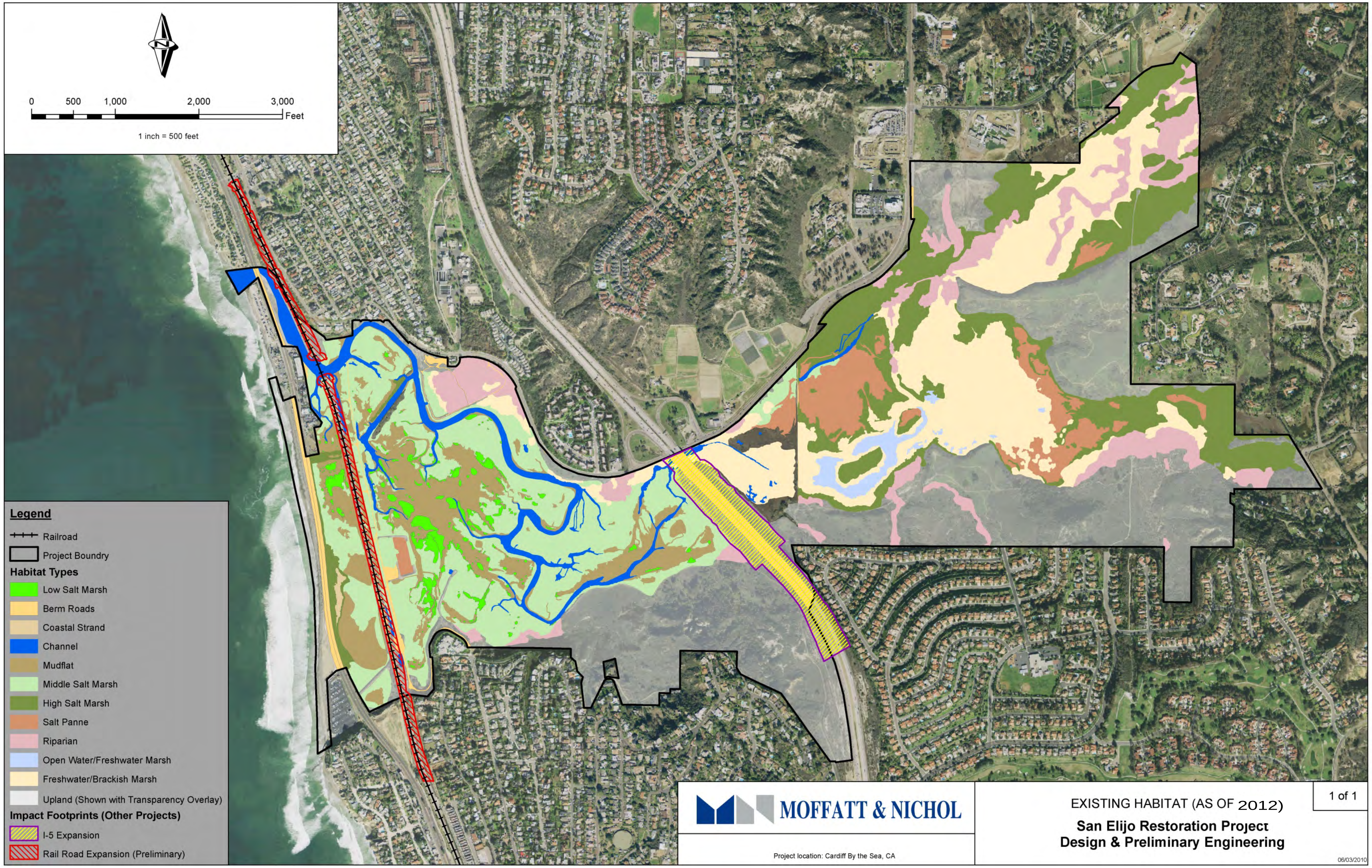


Figure 4-1: No Project - Existing Habitat

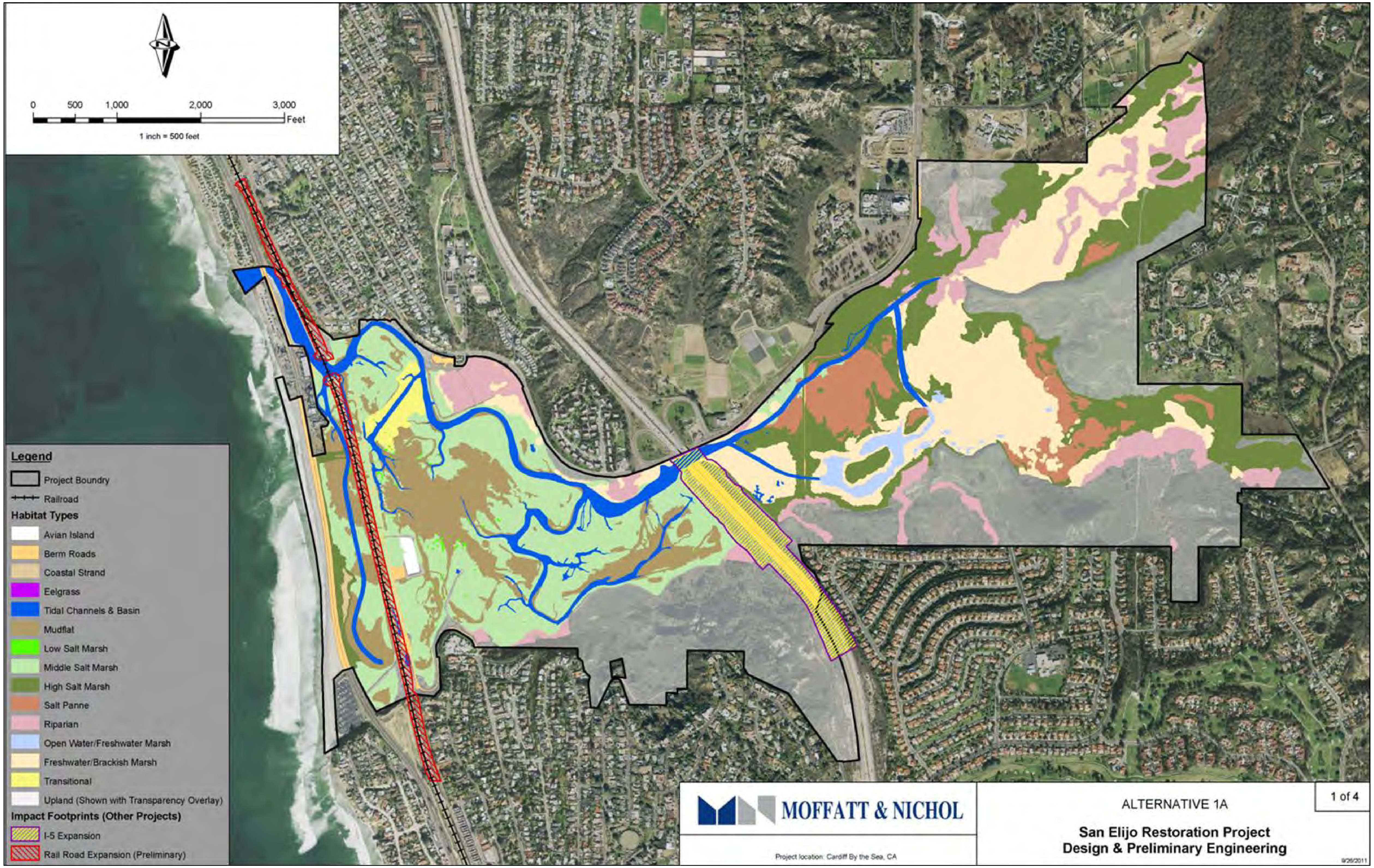


Figure 4-2: Alternative 1A - Minimum Change

4.3 ALTERNATIVE 1B – MAXIMUM HABITAT DIVERSITY, EXISTING INLET LOCATION

Alternative 1B provides a more substantial change to the existing site to create a greater diversity of habitats than currently exist. The existing tidal inlet remains the source of seawater and the main tidal channel extends throughout the Lagoon. A new subtidal basin off the main channel is created in the Central Basin. The main feeder channel is redirected just west of I-5, and extended farther into the East Basin. The channel in the East Basin is significantly enlarged in cross-sectional area to promote more tidal exchange east of I-5. The tidal prism of Alternative 1B will be significantly increased compared to Alternative 1A. Non-tidal habitat areas will still exist in the East Basin. Several areas of transitional habitat above tidal elevations will be placed in the western portion of the Central Basin. Figure 4-3 shows Alternative 1B.

4.4 ALTERNATIVE 2A – MAXIMUM HABITAT DIVERSITY, NEW INLET LOCATION

Alternative 2A also provides changes to the existing site to create a greater diversity of habitats than presently exist. Seawater would enter the Lagoon via a new tidal inlet located south of the existing inlet and a new subtidal basin would be created just landward of the new inlet in the West and Central Basins. The main tidal channel would extend throughout the Lagoon and be redirected just west of I-5, and extend into the East Basin. The channel in the East Basin is identical to that for Alternative 1B. The tidal prism of Alternative 2A will increase compared to Alternative 1B. Non-tidal habitat areas remain in the East Basin. Transitional habitat areas above tidal elevations will also be included in the Central Basin, as with Alternative 1B. Figure 4-4 shows Alternative 2A.

4.4.1 Cobble-Blocking Features

The tidal inlet feature of SELRP Alternative 2A will not possess jetties. Inlets without jetties are vulnerable to sand and cobble entering the channel to clog it and restrict tidal exchange. Sand cannot be effectively blocked from entering an inlet without jetties. Therefore, this inlet will experience significant sand shoaling and tidal muting.

Cobble can be blocked from entering an inlet more effectively than sand because it comprises a smaller volume of material than sand. It also typically moves along the upper portion of the beach profile (between mean sea level and extreme higher high water) and deposits in a layer below the summer beach profile. The cobble layer becomes exposed in winter when the summer beach profile erodes as sand is stripped from the beach. To reduce inlet infilling with cobble, the Project includes two relatively short and low rock features along the outer reach of the tidal inlet channel for Alternative 2A. These proposed rock features are called Cobble Blocking Features, or CBFs, and are intended to block cobble from freely entering the non-jettied tidal inlet.

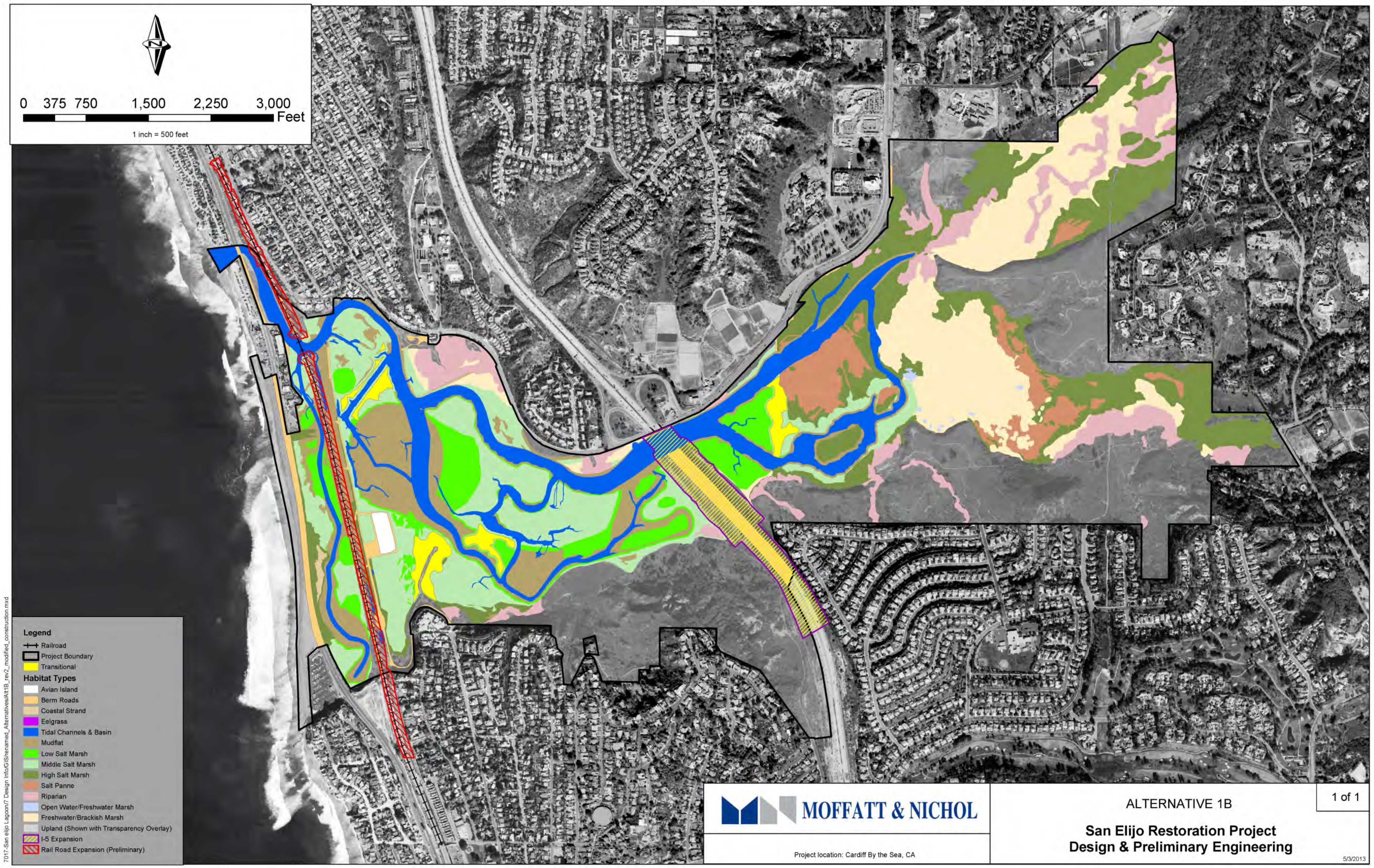


Figure 4-3: Alternative 1B - Maximum Habitat Diversity, Existing Inlet Location

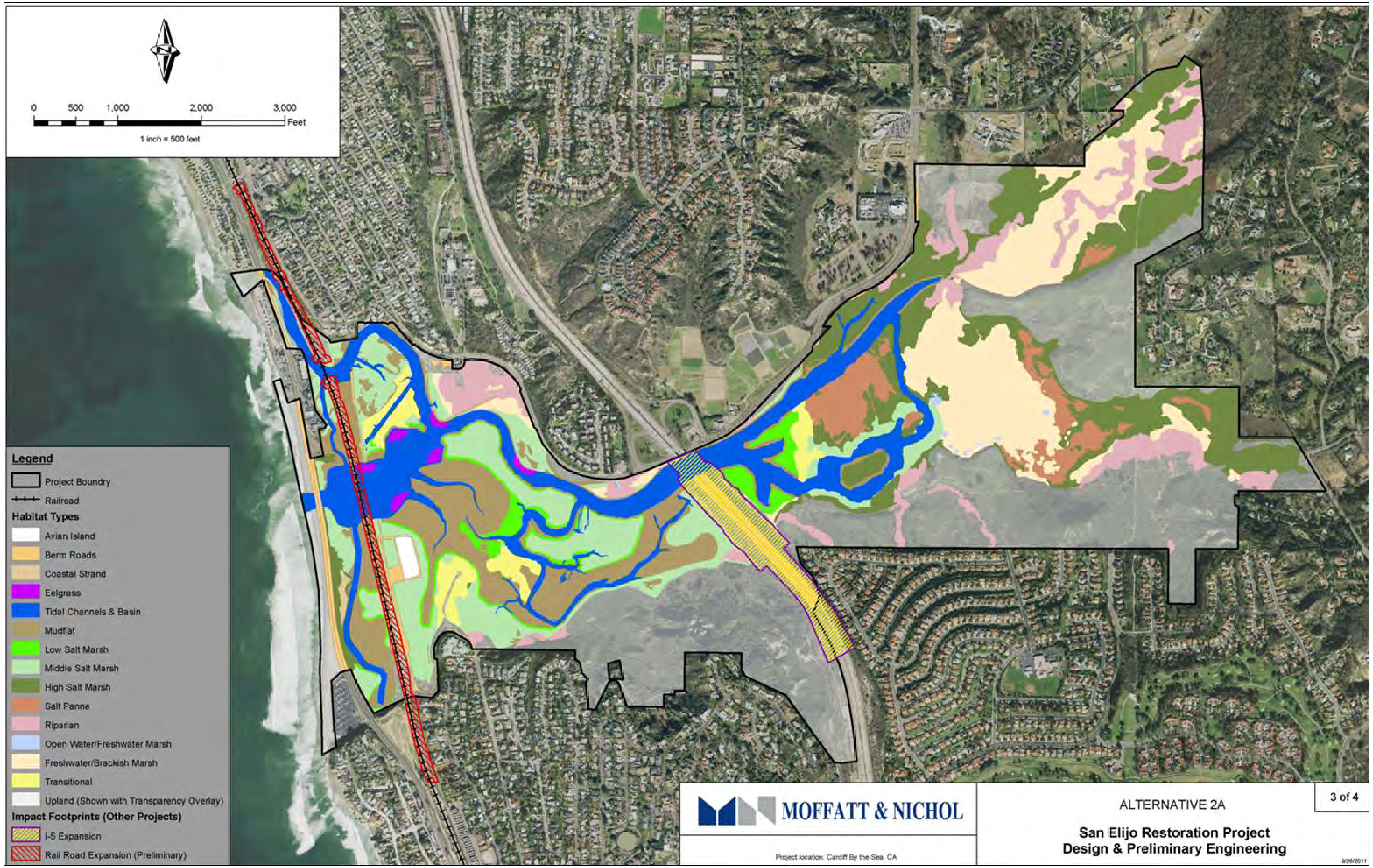


Figure 4-4: Alternative 2A - Maximum Habitat Diversity, New Inlet Location

The CBFs are intended to partially block cobble from entering the tidal inlet channel and to protect the base of the bridge abutment from direct wave attack. The objective is for a significant portion of the cobble to be blocked, and keep any that moves past the CBFs to within the downstream end of the inlet channel. Cobble will then have less opportunity to migrate upstream into the inlet channel, and may continue to move beyond the inlet location to the adjacent downcoast beach. The CBFs should be slightly visible above the beach profile in winter, and then naturally buried completely in summer.

Their design is like very short and stubby jetty-like features. Figure 4-5 shows the feature concept in planform, Figure 4-6 shows it as an engineering diagram, and Figure 4-7 shows it in cross-section.

The planform of the CBFs shows them attached to the bridge abutments and extending seaward approximately 150 feet to the +3 foot mean lower low water (MLLW) contour on the beach. They are approximately 100 feet wide, such as typical jetties (e.g., at Batiquitos Lagoon inlet), and then extend laterally along the highway bridge approach for a distance of 220 feet. Their appearance is similar to a wide grand piano.

In profile, the CBFs are relatively thin, with a foundation elevation reaching down to -5 feet MLLW to remain embedded and stable during significant beach erosion conditions. The footing of the CBFs will be level and extend from the bridge abutment to the -5 foot MLLW contour. The crest of the CBFs will slope upward from the seaward end toward the landward end at an elevation that falls between the typical summer and winter beach profile. The maximum elevation will reach approximately +9 feet MLLW on the highest portion of the landward end of the CBFs.

Construction materials will consist of riprap stone that is large enough to be stable during extreme storm wave events. Rock sizes may consist of 3- to 5-ton stones that are several feet in diameter, nested together to increase the structural integrity of the structure. If desired for aesthetics, the exposed “face” of the CBFs along the inside bank of the tidal inlet channel can be made to look like natural bedrock with a faux cover. This naturalized faux cover could be made to appear like sandstone or other sedimentary features, similar to the treatment on the seawall at south Cardiff State Beach.

Figure 4-5: Cobble Blocking Feature Concept Plan

Figure 4-6: Concept CBF Design

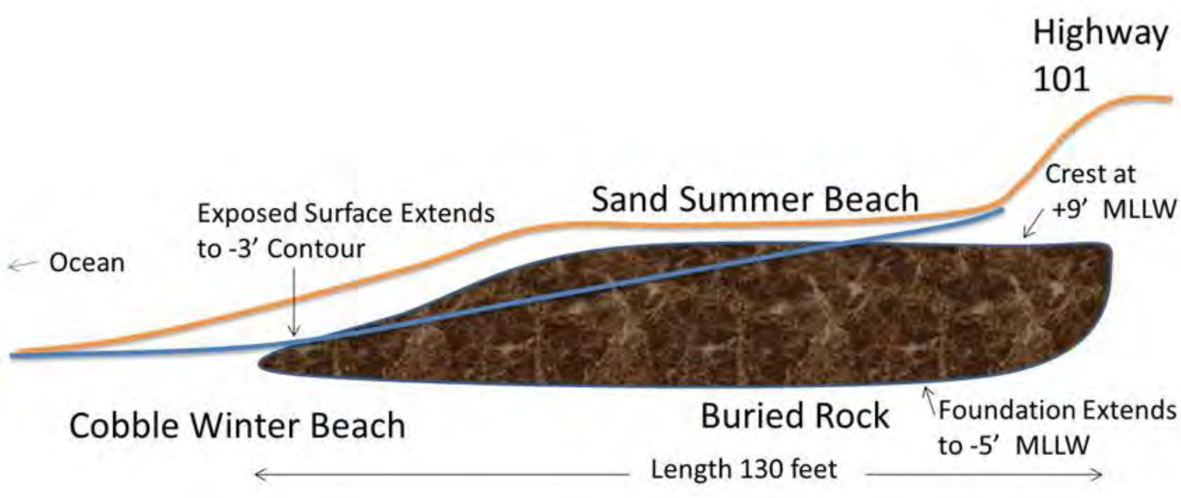


Figure 4-7: Concept CBF Profile

4.5 MATERIAL BENEFICIAL RE-USE

Four sand re-use scenarios are analyzed in this report for the SELRP. Alternatives 1B and 2A include replenishing several San Diego County beaches with up to 1.4 million cubic yards (mcy) of sand. The difference between the alternatives is that:

- Alternative 1B yields 1.2 mcy of sand, and
- Alternative 2A yields 1.4 mcy of sand.

The materials were tested for physical and chemical parameters in accordance with the Inland Testing Manual (ITM) by the Project team. Portions of the export were determined conditionally compatible for on-beach and nearshore beach placement by the U.S. Environmental Protection Agency (USEPA) and the U.S. Army Corps of Engineers (USACE) (Moffatt & Nichol 2013), pending additional review during the permitting phase of the project.

The replenishment sites are located from Torrey Pines Beach in the south to Batiquitos Beach in the north. Sand is proposed to be dredged from within the lagoon and placed on the beach, in the nearshore (at one site – Cardiff Beach), and offshore in former dredge borrow pits created by the first two San Diego Regional Beach Sand Projects by SANDAG. A brief description of each restoration alternative is provided below.

Three scenarios for materials disposal are being carried forward for further analysis in this EIR/EIS. The four materials disposal alternatives include:

- Proximity: Material would be placed as close as possible to the site to maximize beneficial re-use of the material consistent with the Coastal Regional Sediment Management Plan (RSM Plan) for San Diego (M&N et al. 2009).

- Lowest cost: Material would be placed based on lowest possible costs rather than emphasizing goals of the RSM Plan. This would require as much material as possible to be disposed of in former SANDAG borrow pits, except sand placement at Cardiff Beach and in the nearshore, to provide a stable ebb bar for the relocated inlet under Alternative 2A.
- Low cost hybrid: Material would be placed to meet the RSM Plan goals, taking into account economic considerations that may make transport of sand to locations further from the Lagoon too expensive.

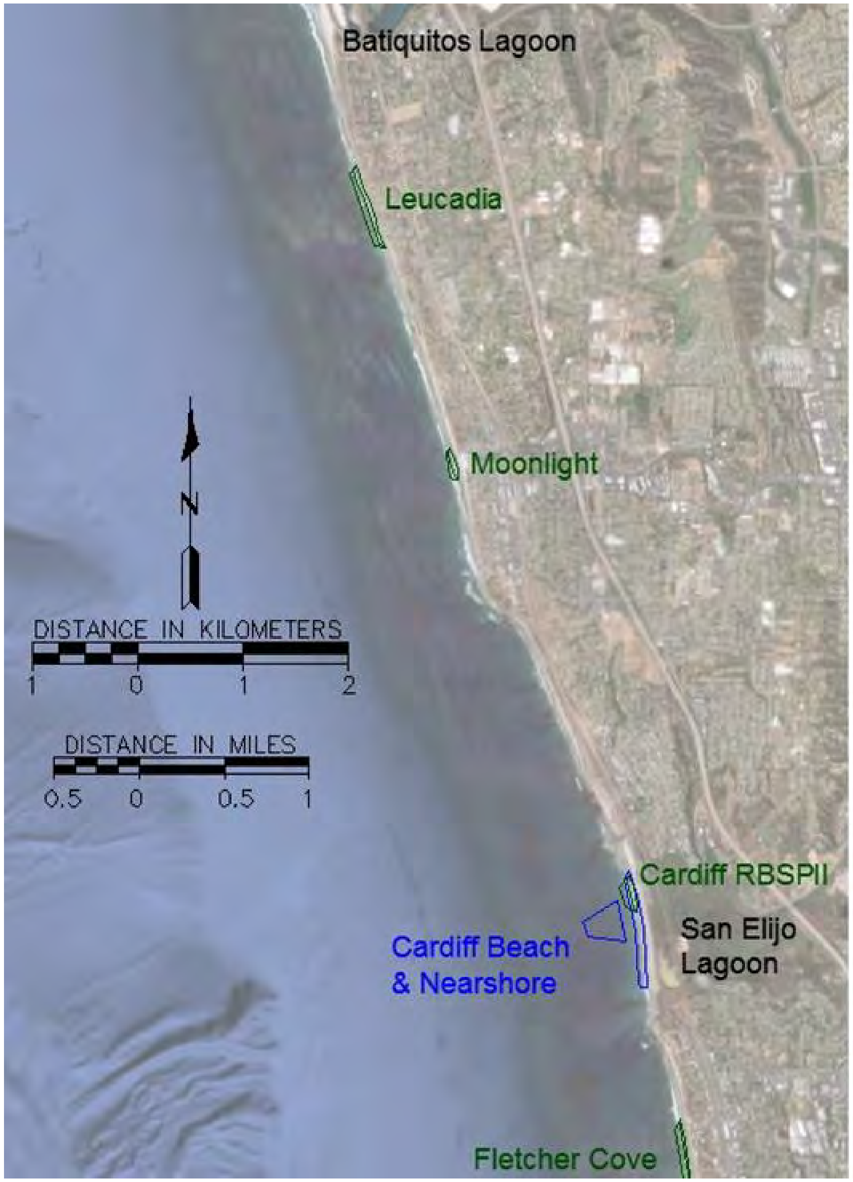
It should be noted that other potential uses for dredged materials include the creation of a concrete batch plant onsite. The dredged materials would then be used for supplying fill material for transportation infrastructure projects, such as improvements being made to the Los Angeles-San Diego (LOSSAN) Rail Corridor and Highway 101. Highway 101 can utilize approximately 10,000 cy of fill for raising associated with Alternative 2A, and the LOSSAN corridor may be able to use up to 70,000 cy for raising and widening the railway (Smith 2012).

Dredging and beach fill quantities for each scenario are presented in Table 4-1. Beaches will be formed by deposition of sand from the dredge discharge line. The sand will be initially pumped into training dikes to control placement and reduce turbidity. The sand will then be shaped to the desired dimensions (elevation, width, and slope) with bulldozers, as indicated in the construction drawings and specifications. Generally, beaches will be constructed to elevations up to +12 feet above MLLW. The post-construction upper slope will be steeper than the pre-construction profile, but will quickly and naturally evolve toward an equilibrium average nearshore slope, which is a function of sediment grain size and wave characteristics. The beach fill will naturally disperse over a wider portion of the beach and nearshore zone, resulting in a flatter profile. Flattening of the slope and adjustment of the beach profile causes reduction of the berm width from the post-construction profile.

The configurations of the beach fills (length, width, and slope) were tailored to each site, depending on the quantity of sand to be placed and environmental constraints. A number of the beach fill footprints are the same as those developed for the previous SANDAG Regional Beach Sand Projects I and II. Figure 4-8 shows the beach and nearshore placement locations proposed for consideration as part of the Project, and Figure 4-9 and Figure 4-10 show the specific footprints proposed at Cardiff Beach and nearshore for Alternatives 1B and 2A, respectively.

Table 4-1: Sand Quantities Proposed Under Each Alternative

Potential Disposal Locations			Annual Max Disposal Amount (cy)	Potential Scenarios						
				I. Alternative 1A	II. Proximity (Assumes previously permitted volumes/sites)		III. Lowest Cost		IV. Low Cost Hybrid	
				Alt 1A	Alt 1B	Alt 2A	Alt 1B	Alt 2A	Alt 1B	Alt 2A
Offshore Placement Sites		LA 5		150,000						
Offshore Placement Sites		SO-5/SO-6			Alternative site to Cardiff nearshore (300,000 cy)		600,000	600,000	300,000	300,000
Nearshore (inside littoral zone)		Cardiff			300,000	500,000	300,000	500,000	300,000	500,000
On-beach Placement Sites	Non-RBSP site	Cardiff			300,000	300,000	300,000	300,000	300,000	300,000
On-beach Placement Sites	RBPS II Sites	Leucadia	117,000		117,000	117,000			117,000	117,000
On-beach Placement Sites	RBPS II Sites	Moonlight Beach	105,000		105,000	105,000			105,000	105,000
On-beach Placement Sites	RBPS II Sites	Solana Beach	146,000		146,000	146,000			146,000	146,000
On-beach Placement Sites	RBPS II Sites	Torrey Pines	245,000		245,000	245,000				
Disposal Option Capacity (cy)				**150,000**	**1,213,000**	**1,413,000**	**1,200,000**	**1,400,000**	**1,268,000**	**1,468,000**



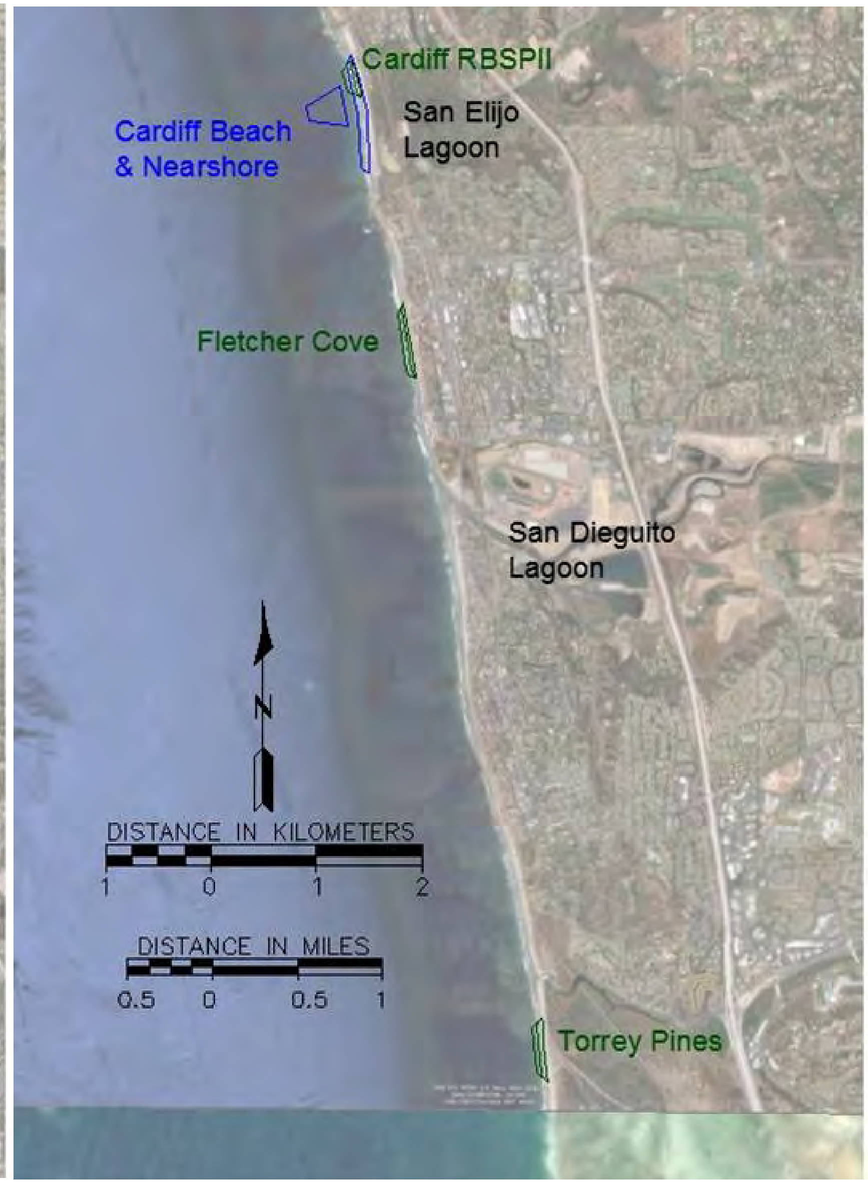


Figure 4-8: Potential Sand Re-Use Locations for the Littoral Zone

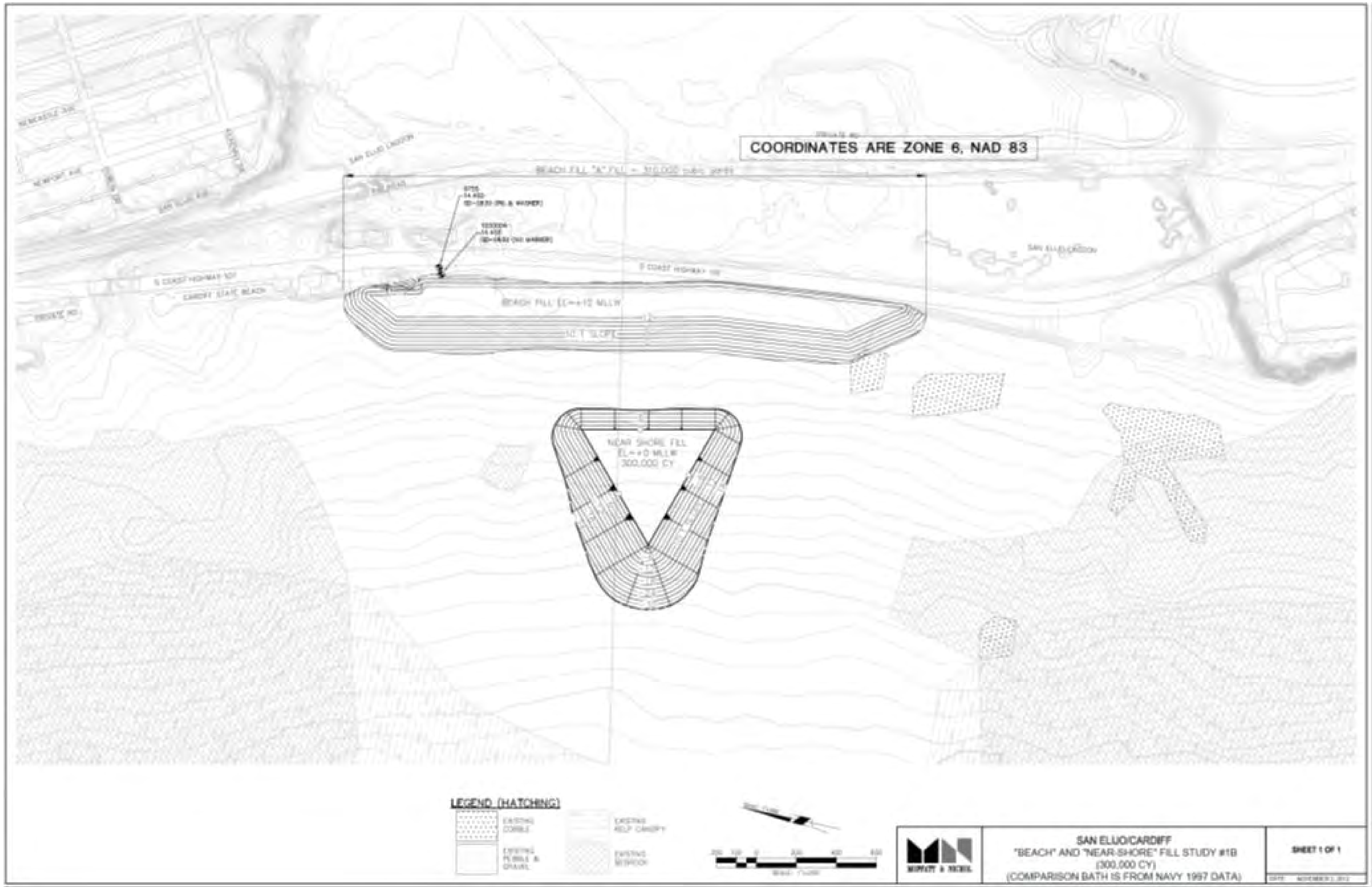


Figure 4-9: Cardiff Beach and Nearshore Placement Locations for Alternative 1B

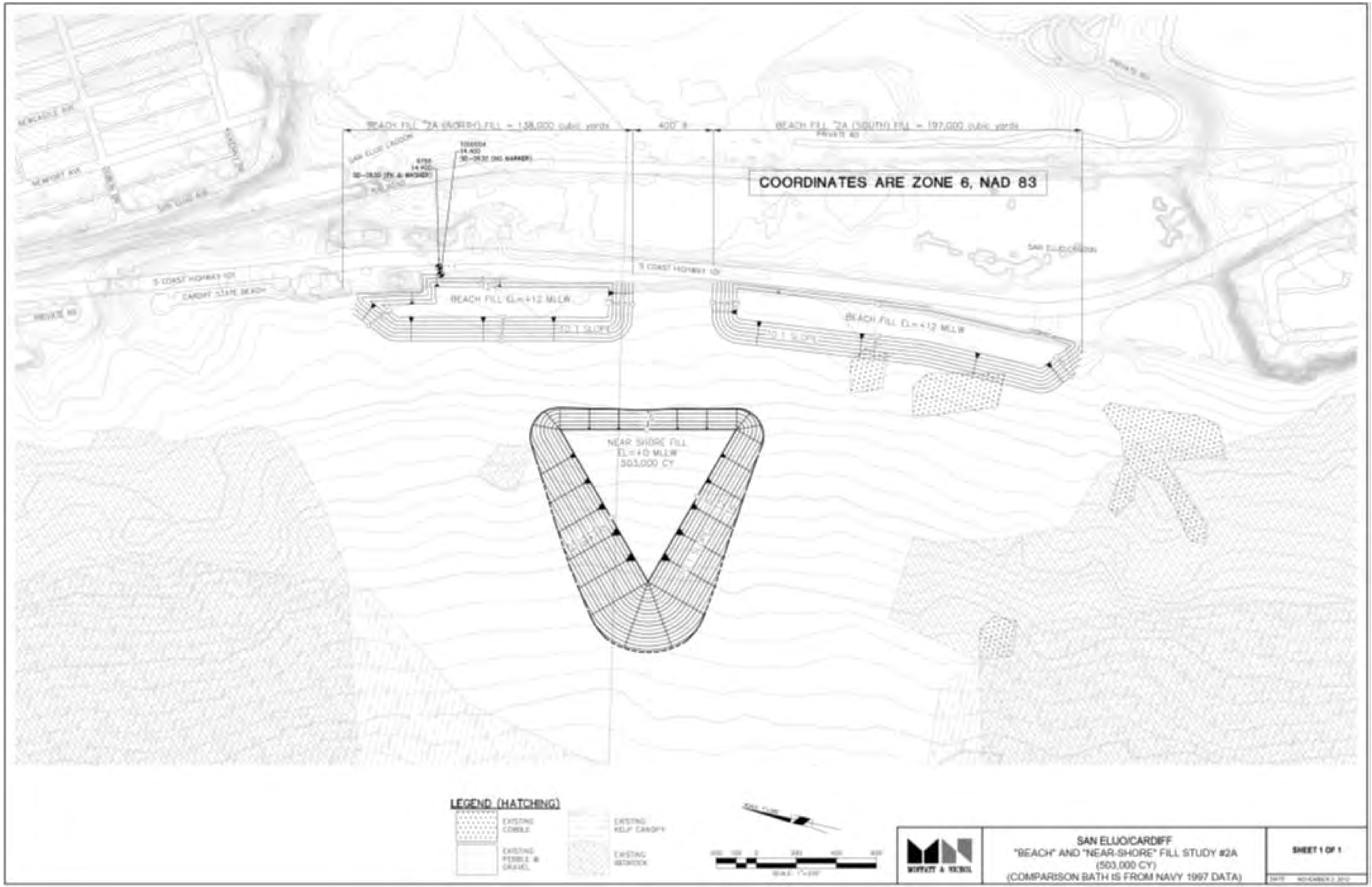


Figure 4-10: Cardiff Beach and Nearshore Placement Locations for Alternative 2A

5. COASTAL SETTING

The coastal setting of the project area is described below. It consists of tides, bathymetry, waves, geomorphology, water quality, wind, and public use.

5.1 TIDES

Tides in Southern California are mixed semi-diurnal type, which means during a typical lunar day (about 24 hours) there will be two high and two low tides, each of different magnitudes. Tidal peaks typically occur during the winter season that can exacerbate the coastal impacts of winter storms.

Tidal characteristics measured in La Jolla (Station ID: 9410230) are considered representative of the tides within the study area. NOAA has established a tidal datum for La Jolla based on 18 years of collected measurements from 1983 to 2001 tidal epoch. Table 5-1 presents the tidal characteristics of the La Jolla tidal station, referenced to the MLLW vertical datum. The highest recorded sea level recorded at the gauge was 7.65 feet measured on November 13, 1997.

Table 5-1. Tidal Characteristics at Scripps Pier in La Jolla, California

Datum	Elevation (feet, MLLW)	Description
MHHW	5.33	Mean Higher High Water
MHW	4.60	Mean High Water
MTL	2.75	Mean Tide Level
MSL	2.73	Mean Sea Level
DTL	2.66	Mean Diurnal Tide Level
MWL	0.90	Mean Low Water
NAVD88	0.19	North American Vertical Datum of 1988
MLLW	0	Mean Lower-Low Water

Source: NOAA Tides & Currents (http://tidesandcurrents.noaa.gov)

5.2 GEOMORPHOLOGY AND BATHYMETRY

The Project area possesses variable geomorphology, with a series of uplifted seacliffs interspersed with river valleys that form lagoons. The coastal reaches fronting seacliffs form wave-cut terraces at the base of the bluffs, resulting in shallow bedrock reefs along significant stretches of this coast. Shallow reefs exist along north Encinitas, San Elijo State Beach, and throughout Solana Beach. Sand channels and sand bars exist off lagoon mouths and between reefs. One of the main attractions is the reef breaks that typify this area.

As a result, bathymetry can be quite variable throughout this Project reach. No large-scale bathymetric depressions, such as submarine canyons, exist along this shore. Bathymetric promontories exist at Swami's Point in southern Encinitas and at Tabletops Reef in northern

Solana Beach. Cardiff Reef is another significant bathymetric feature protruding into the nearshore zone.

The more subtle bathymetric variations represented by the reefs (combined with ocean swell) generate the abundance of well-shaped ridable surf throughout the year.

5.3 WAVE EXPOSURE / WAVE CLIMATE

Four main categories of ocean waves occur off the coast of Southern California: 1) northern hemisphere swell, 2) tropical swell, 3) southern hemisphere swell, and 4) seas generated by local winds. Each wave type is described below.

- Northern hemisphere swell includes the most severe waves reaching the San Diego County coast. Deepwater significant wave heights rarely exceed 10 feet, with wave periods ranging from 12 to 18 seconds. However, during extreme northern hemisphere storms, wave heights may exceed 20 feet with periods ranging from 18 to 22 seconds.
- Tropical storms develop off the west coast of Mexico during the summer and early fall. The resulting swell rarely exceeds 6 feet, but a strong hurricane in September 1939 passed directly over the Southern California area and generated waves recorded at 26.9 feet.
- Southern hemisphere swell is generated by winds associated with winter storms in the South Pacific. Typical southern hemisphere swell rarely exceeds 4 feet in height in deep water, but with periods ranging up to 18 to 21 seconds, they can break at over twice that height.
- Sea is the term applied to steep, short-period waves which are generated either from local storms, strong pressure gradients over the area of the Eastern Pacific Ocean (Pacific High), or from the diurnal sea breezes. Wave heights are usually between 2 and 5 feet with an average period of 7 to 9 seconds.

A wave exposure diagram is shown in Figure 5-1. The San Diego region is directly exposed to ocean swell entering from three main windows (M&N 2000; USACE 1989). The northernmost window extends from approximately 310 to 280 degrees (relative to true North), where wind waves cause local seas in the Santa Barbara Channel that can travel to San Diego County. The northwest window, where severe northern hemisphere storms enter, extends from 290 to 250 degrees. The Channel Islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa) and Santa Catalina Island provide some sheltering from the higher waves associated with these two windows, depending on the approach direction. The other major exposure window opens to the south from 250 to 150 degrees, allowing swell from southern hemisphere storms, tropical storms (hurricanes), and pre-frontal seas.

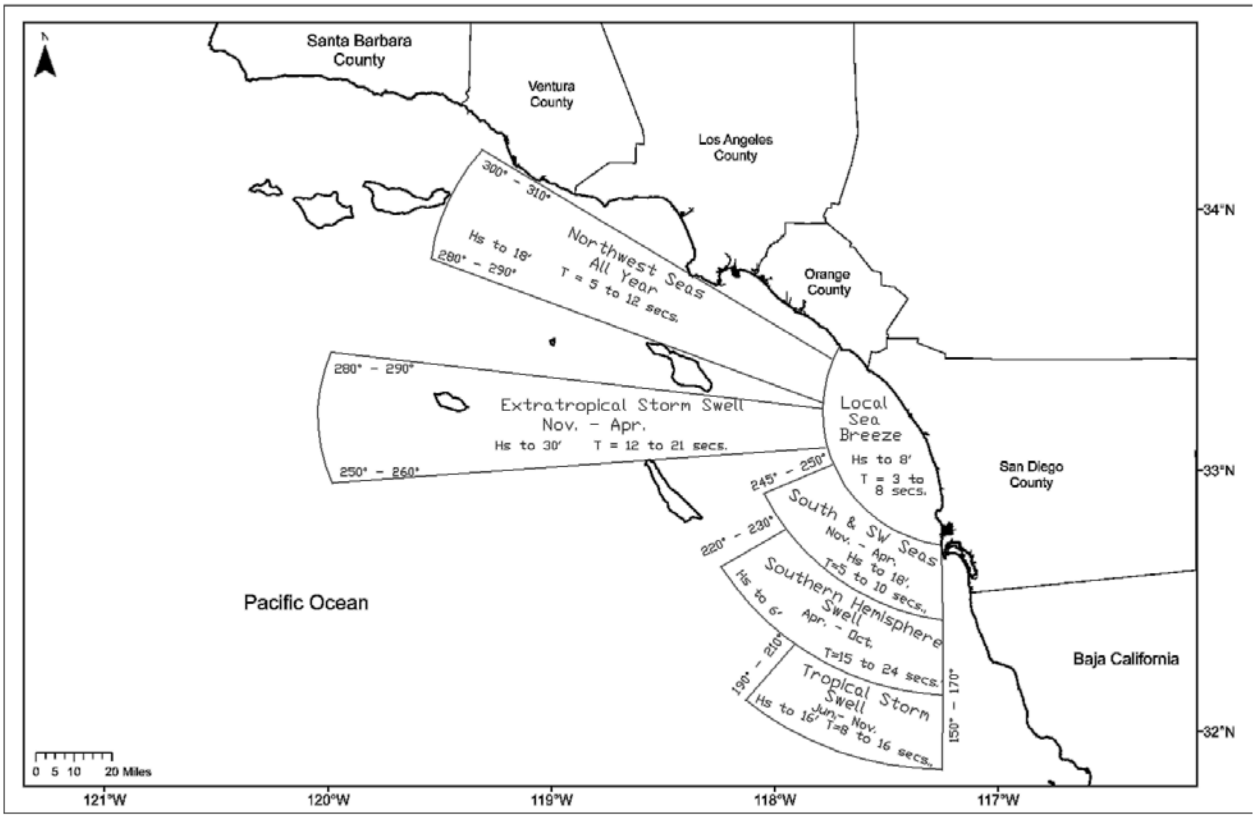


Figure 5-1: San Diego Wave Exposure

5.4 PREVAILING WINDS

Southern California experiences a prevailing land breeze at night and in the early morning from thermal cooling of land versus water. The region also experiences the opposite effect in the afternoon, a prevailing sea breeze in the daytime from thermal heating of land versus water. The sea breeze in the region is typically out of the northwest and its formation results in locally generated wind-waves. These wind-waves are responsible for “blowing-out” or causing poor surfing conditions in many locations. Blown-out conditions occur at various times depending on the strength, fetch, and duration of the sea-breeze; however, chop typically occurs by late-morning to early afternoon.

Other wind conditions can exist, such as onshore winds in the fall and winter months following storms, and a pre-frontal southwest wind during an approaching storm. “Santa Ana Winds” blow offshore and can form from establishment of a large-scale, high atmospheric pressure system inland causing airflow toward lower pressure areas along the coast.

This Project reach is characterized with bluffs and kelp that both serve to shelter this coast from wind, so conditions can remain clean longer than other areas along the coast. Winds are less of a factor within this study reach than at other areas, although they are still a very important consideration.

5.5 PUBLIC USE

Public use of the coast consists of various user groups. These groups are lumped into the two main groups of surfers and non-surfers for the purposes of this study. Non-surfers are referred to as recreational beach users in this report. The City of Encinitas estimated beach visitation to local beaches for a number of years using electronic sensors at eight popular beach access points (City of Encinitas 2008). Data from these points were extrapolated to other beaches within the City to gain annual beach visitation estimates. Estimates of the City of Encinitas beach visitation from 2000 to 2007 are shown in Figure 9. A trend in increased beach use over time appears to exist from the data.

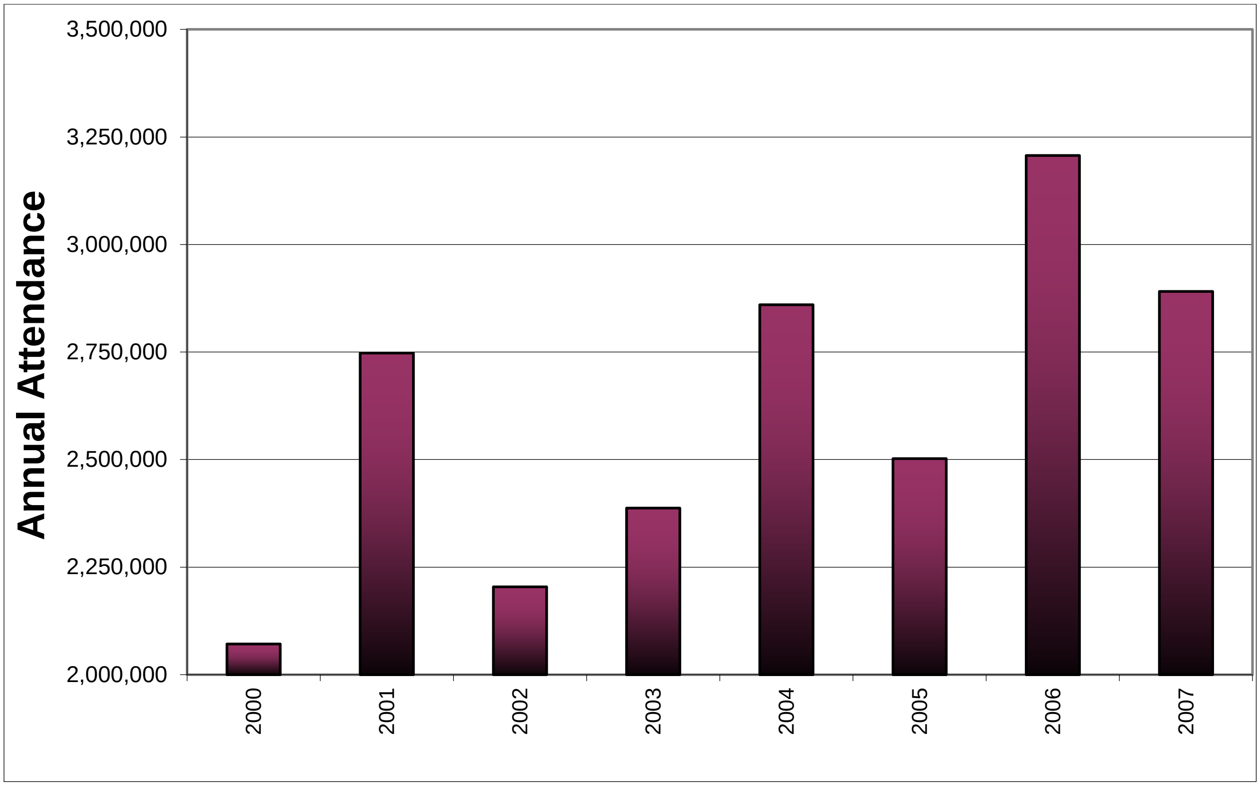


Figure 5-2: City of Encinitas Annual Attendance (City of Encinitas 2007)

Based on these data, annual beach attendance in the City was 2.9 million in 2007. This value includes Cardiff State Beach as an extrapolated value from the eight counting locations. Cardiff was considered a medium-frequency-of-use beach, with an annual visitation of approximately 250,000 people.

The annual attendance within the City of Solana Beach is estimated at 124,700 people (CIC 2010) based on attendance counts from July 2008 to July 2009.

Clearly, the coast attracts many users. This coast is popular and intensely used during normal daylight hours. The Monitoring Results section of this report presents more detail on beach and surfing public use along the study area.

6. EXISTING SURFING CONDITIONS

Surfing is an important resource for recreation in the study area. The study area contains over 14 distinct sites that are frequently surfed and have unique characteristics, as described in this section.

The study area was divided into three reaches (Cardiff, San Elijo, and Solana Beach) for the purposes of this discussion. The extent of these reaches and surf spot names within them are shown in Figure 6-1. Bold name labels correspond to the surf spots that were included in the detailed monitoring program by the SELC.

In terms of rating the surf spots for recreational value, the following metrics were used relative to wave quality and frequency of use:

- Wave Quality
    - Excellent: Long rides, can be ridden by both longboards and shortboards.
    - Good: Slightly lower quality, but still high quality for riding.
    - Moderate: Average quality that can exist on the majority of days and provides rideable conditions.
    - Poor: Below average in quality, presents a poor and potentially frustrating riding experience.
- Frequency of Use:
    - Highly – Surfed >300 calendar days a year
    - Moderate – Surfed 150-300 calendar days a year
    - Low – Surfed <150 calendar days per year

6.1 CARDIFF REACH

This stretch of coastline is 1.7 miles long and extends from Swami's to Cardiff Reef and consists mostly of reef breaks, however, sandy areas and beach breaks do exist. The abundance of surf spots suitable for any surfing skill level, year-round swell exposure, and kelp protection make this area one of the most popular surfing areas in San Diego County. Although this area is generally considered better during the winter (Fall / Winter /Spring) due to direct exposure to northern hemisphere swells, the reach is also exposed to swells out of both the southwest direction and can continue to provide surfing through the summer season.

Offshore kelp beds persist year-round approximately 0.5 miles offshore along the majority of this reach. This offshore feature is favorable to surfing because it can significantly reduce water surface texture (or chop) created by onshore winds, allowing for cleaner surface conditions inboard of the kelp than other areas. Although the kelp bed density varies from year to year, generally the thickest areas exist offshore of Swami's and the San Elijo State Campground area as shown in Figure 6-2.

Figure 6-1: The Reaches and Surf Spots in the Study Area (study locations enlarged in white)

Figure 6-2: Kelp Distribution in the Study Reach

The reach is made up of the following surf spots:

- **Boneyards:** Moderate reef-break peaks immediately north of Swami's. Scattered left and right-hand peaks along a large outside reef. The wave breaks approximately 500 feet offshore and most waves are fairly mushy with occasional hollow sections contingent on tide and swell. Fairly consistently surfed, but has a low over-all crowd volume. Can become moderately crowded when Swami's is extremely crowded.
- **Swami's:** Excellent right-hand, reef point break. One of the most popular and heavily surfed breaks in the region due to the length of ride and ability to hold the largest winter swells. It is rideable at most any size but is considered better with size when rights connect through the entire length of the reef. The large deep channel to the south allows an easy paddle out even during the largest swells. Can offer hollow sections on the inside on larger swells. A short left also exists off the tip of the point. Highly surfed and excellent wave quality.
- **Dabbers:** Left and right-hand, reef and sand bottom wave. Spot is said to break during big north swells but has not worked for quite some time. Therefore, the wave is infrequently surfed and overall wave quality is low at this time.
- **Brown House:** Scattered left and right-hand peaks. Mostly sand with some scattered reef. The spot is frequently surfed and is a moderate to low wave quality.
- **Pipes:** Primarily a fast and semi-long left-hand reef break, though shorter rights off the peak also exist. Reef break with some scattered sand throughout the inside section. Works on both northwest and southwest swells. The wave quality is good and is consistently surfed. The wave is generally on the mushy-side through can be hollow dependent on swell size and direction.
- **Traps:** A-frame reef break with some sand scattered throughout. Short right and longer left that allows a few maneuvers in either direction. After breaking on the outside, the right slows down when it hits a deep spot and then reforms and typically closes out on the inside. Consistently surfed due to wave form and channels. Spot is more shadowed to southwest swells than some of the other breaks in this region. Moderate wave quality.
- **Barneys:** Scattered peaks along a broad stretch of reef whose form can vary significantly based on wave direction(s) and tide. Best during northwest swells and is typically surfed by less experienced surfers. Spot is more shadowed to southwest swells than some of the other breaks in this region. Highly surfed and moderate wave quality.
- **Turtles:** Defined and fairly long left and right-hand reef break. Can hold significant sized swells, however, it cannot hold waves as big as those held by Swami's and Cardiff Reef. During large northwest swells, it can produce a short and very hollow right-hand wave. Spot offers good wave quality and is heavily surfed due to its consistency and ability to

handle a variety of conditions and tides. Spot is more shadowed to southwest swells than some of the other breaks in this region.

- **85's:** Right hand reef break. Works primarily in the winter with northwest swells under approximately 8 feet. Wave can be fast and very maneuverable, therefore, is typically ridden by short boarders. Spot is more shadowed to southwest swells than some of the other breaks in this region. Moderately surfed and good wave quality.
- **Tippers:** Left and right hand reef break. Is best during winter northwest swells, however, is exposed to and breaks during both northwest and southwest swells. The left is generally longer with better form than the right. The left can offer a hollow section during the right swell and tide condition. Highly surfed and good wave quality.

6.2 SAN ELIJO REACH

This stretch of coastline is 1 mile long, extends from Cardiff Reef to Seaside Reef (inclusive), and consists of mostly beach break with distinct reef features at each end of the reach. Offshore kelp is scarcer in this area and wind has a more direct and detrimental effect on this section of coastline. This stretch is also at the head of a canyon through the river valley serves to funnel breezes in both directions, both to and from the sea leading to increased sea and land breezes. Thus, this stretch is the most susceptible reach in this study area to the effects of wind. This reach is made up of the following surf spots:

- **Cardiff Reef:** Long left and right-hand point break. Due to its size, the area is divided into two sub-breaks (namely South Peak and Suckouts). The position of South Peak varies depending on swell direction, however is generally located directly off of the river mouth. The wave is right-hand, reef point-break with some scattered sand (mostly on the inside). The wave offers a long and typically slow ride, which makes it very popular with long boarders, riders with fun-board shapes, and stand-up paddleboards during average wave conditions. During above average conditions, and especially during larger swells from the southwest and northwest, the wave becomes faster and sometimes hollow and can allow for waves with multiple maneuvers for shortboards. The spot can hold the largest waves of the season and also provides a channel on the south side of the break. Suckouts is a fast, hollow, left- and right-hand reef break located immediately seaward of the river mouth. The wave is known as the hollowest in the reach. The wave is highly surfed by short boarders because of its power compared to some of the other breaks in the region. Works during both northwest and southwest swell directions and typically maxes out around 8 foot. Both breaks are highly surfed and have excellent quality.
- **Georges:** Long stretch of beach break with scattered peaks. While often plagued with waves that are too fast or closeouts, the stretch can produce fast left and rights at times

with favorable tides and swell. The reach is not protected by kelp, so afternoon sea breezes can be problematic. Typically prefers mid to high tides and a mix of swells in the water. It is also popular during cleaned-up storm surf days during the winter.

- **Parking Lots:** Inside beach break located just north and on the inside of Seaside Reef. Smaller (generally less than 6 foot) left and right peaks during right swell and tide combinations. Typically best during small, short-period northwest swell. Highly surfed and moderate quality when breaking.
- **Seaside Reef:** Offshore, shallow reef feature creates a fairly long right and left-hand wave. The left is more consistent, longer and is considered the better wave. Works during both southwest and northwest swells. The wave breaks fairly abruptly over a shallow reef offering hollow waves at times.

6.3 SOLANA BEACH REACH

This stretch of coastline is 1.5 miles long and extends from Tabletops in the north down to the cliff edge north of Del Mar River Mouth in the south. Solana Beach has a very similar swell exposure as the Cardiff and San Elijo reaches, however, the surf break density is lower in this reach. Similar to Cardiff, the reach is protected by offshore kelp. However, the kelp bed density is lower than that of the Cardiff reach; therefore, the site is more susceptible to blown out conditions.

The Solana Beach region offers many beach breaks, which allow surfers to spread out over the reach. However, the qualities of these beach breaks are much lower than that of the nearby reefs. The reef breaks that exist in Solana Beach (with the exception of Tabletops) are less defined than those to the north are, and the general form is not as high quality as some of the breaks in the Cardiff reach. However, with the right sand, swell, and tide, these breaks can be very good. Due to the fair quality of the majority of these breaks, they are less heavily surfed than breaks within the Cardiff reach.

Solana Beach sea cliffs are closer to the waterline than Cardiff and the backwash from high tides have a more noticeable effect on the waves in this reach. Solana Beach surf spots are generally susceptible to backwash when high tides approach the cliff face, which can significantly degrade wave quality. Beach conditions dictate the extent of this phenomenon. The reach is made up of the following surf spots:

- **Tabletops:** Left and right-hand reef break that breaks approximately 1,000 feet offshore. A short right breaks off of the far southern fringe of the reef and a longer left breaks in the central portion. Works during both southwest and northwest swells but is generally considered best during southwest swells. The left can be long. Frequently surfed and good quality.

- **Pillbox:** Left and right-hand reef break. Wave breaks on a fairly shallow, offshore reef feature that then connects to an inside beach break section. Dependent on swell direction, the wave can be a longer left or right. The wave is sensitive to changes in sand and also tide. Tides greater than about 3 feet results in backwash as the waves approach the adjacent bluff face. The wave is good quality when breaking and yields moderate crowds due to its form and central location.
- **Cherry Hill:** Scatted reef and beach break with right- and left-hand waves. The offshore reef offers sections to an otherwise walled swell. Frequently surfed and moderate wave quality.
- **Rockpile:** Left and right A-frame reef break. Wave breaks offshore and breaks relatively slowly in both directions. Allows for few maneuvers and is popular with longboards because of its slow nature. The inside section can be faster and is surfed by shortboards. Highly surfed and good quality.
- **Secrets:** Left and right offshore reef break. Generally requires a larger swell out of the northwest and medium to low tide. Can offer long and sometimes hollow rights that allow for multiple maneuvers. Good quality and moderate to low surf frequency.
- **Del Mar River Mouth:** Fast left and right beach break. Breaks during both southwest and northwest swells; however, is generally best during a northwest swell. Fast, hollow right-hand waves. Is most frequently surfed in the winter and is relatively inconsistent. Moderate quality and moderate surf frequency.

6.4 SURFING MONITORING PROGRAM

A surf-monitoring program was conducted to objectively characterize and quantify existing conditions for use in analyses. All site observations were conducted by SELC staff, Tim Stillinger, a long-time surfer and resident of Cardiff by the Sea. Data were collected between 8 am and 12 pm twice a week for six months from October 1, 2011 through March 31, 2012. A total of 48 days of observations were collected at each of the 10 monitoring sites. The sites span a 4-mile stretch of coastline and were collected from north to south or from south to north each day (direction chosen at random to minimize effect of differences in conditions between early and late morning). Data generated by the program are presented in Appendix A.

General beach use data (both people on-beach and surfing) were collected along three segments of coast within the study area. Data from these reaches are presented in this section.

6.4.1 Non-Surfer Beach Use

Non-surfer beach usage data collected during the study show the numbers of people who used each stretch of coast. The data are presented below and are shown in Figure 6-3 and Figure 6-4. Spikes can be seen at all locations around the holidays (e.g., Thanksgiving, last week of the year). The Cardiff Reach consistently had the most beach goers, as shown in Figure 6-4. Multiple factors may be the cause of this trend. This reach is directly below the San Elijo State Beach Campground and sees added foot traffic from the campground. The Solana Beach reach showed the least foot traffic of the reaches, partially because of decreased access at high tides. Many days during the study, the water level was too high in Solana Beach to access the beach, with breakers crashing aginst the cliff. On these same days, there was still dry beach for people to walk on along the San Elijo and Cardiff Reaches. More specific data by reach are provided in Appendix A.

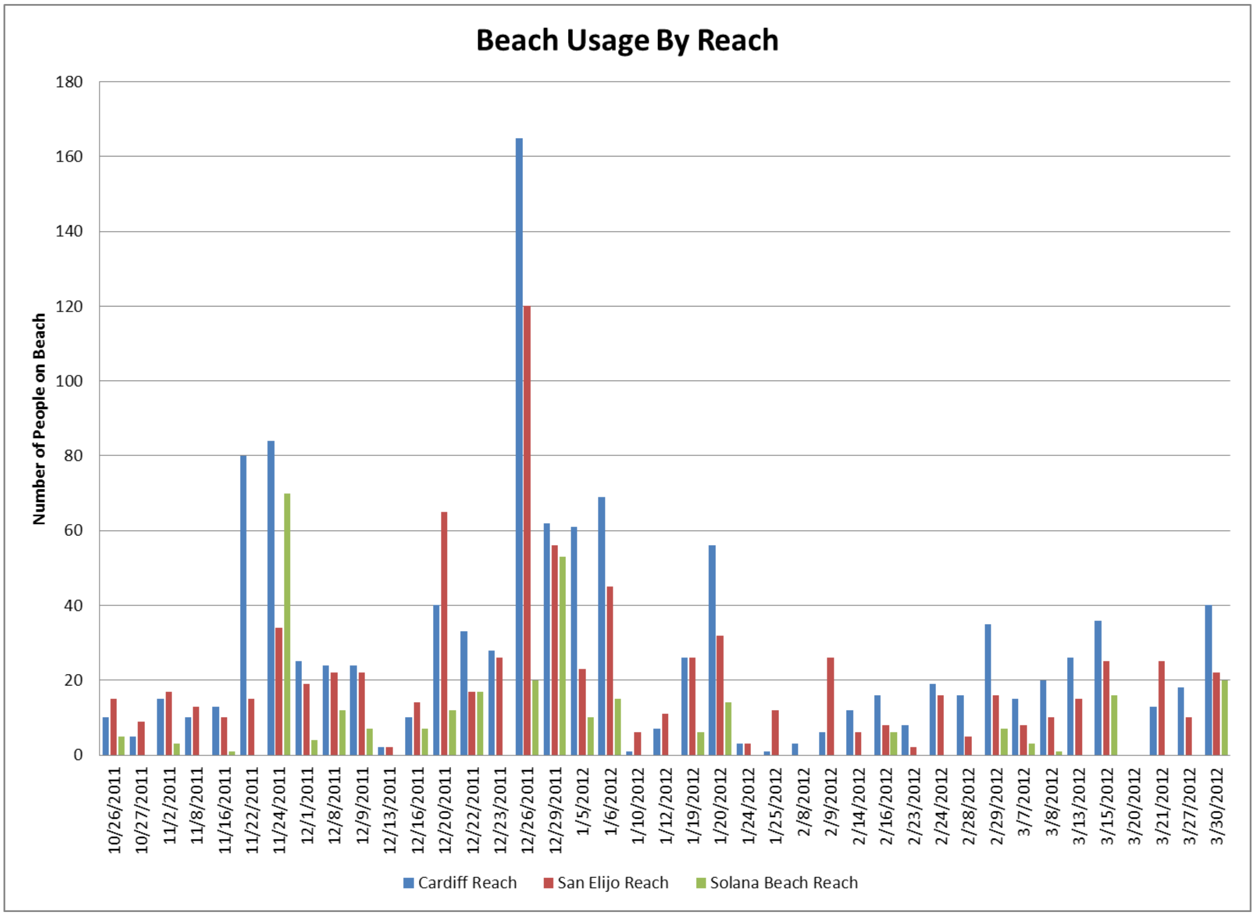


Figure 6-3: Overall Beach Use Over the Monitoring Period

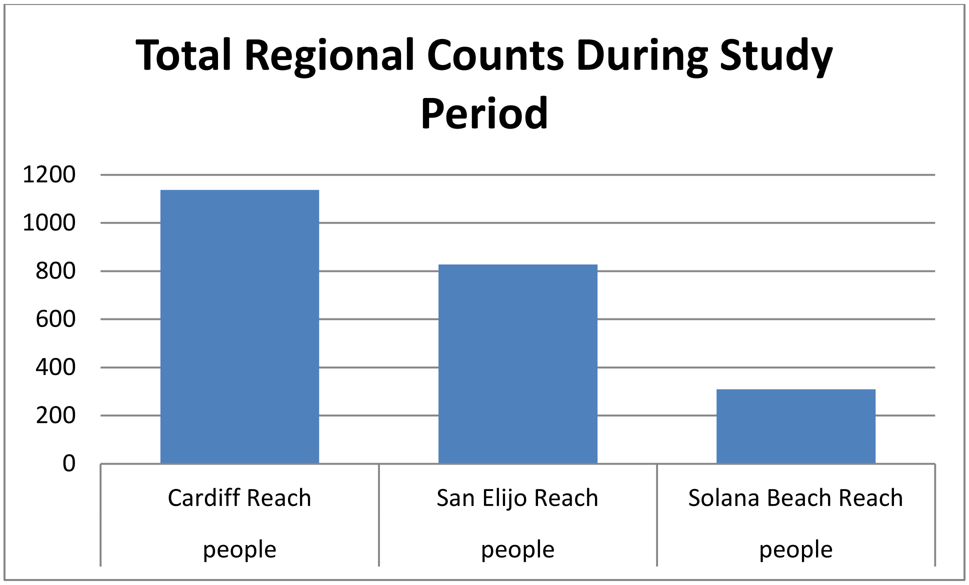


Figure 6-4: Beach Use Over the Monitoring Period by Reach

6.4.2 Surfer Use

The surfer counts by reach for the study period are presented below and shown in Figure 6-5 and Figure 6-6. The Cardiff Reach consistently was attended by more surfers than any other reach. Several reasons may exist for the increased attendance at the Cardiff Reach. While the reaches are all similar lengths of beach, there are more surf spots along the Cardiff reach than in the other reaches. Also, the Cardiff reach sees use from the State Campground as well as beach visitors, and benefits from multiple public parking lots, easy beach access, and good waves. In terms of absolute area available for visitation, the Cardiff reach is the longest of the reaches, so this could be an additional reason for increased surf usage.

Comparing surfer use to general public use, the number of surfers using the Cardiff Reach is approximately threefold the number of general beach users. The numbers of surfers and general beach users along the other reaches are similar to each other. Surfing appears to be the “big draw” of visitors to the Cardiff Reach over the study period.

The distribution of surfers over the study reach varies depending on wave conditions. Figure 6-7 shows the number of surfers observed during fair to good conditions, and each site is shown to host up to a dozen surfers.

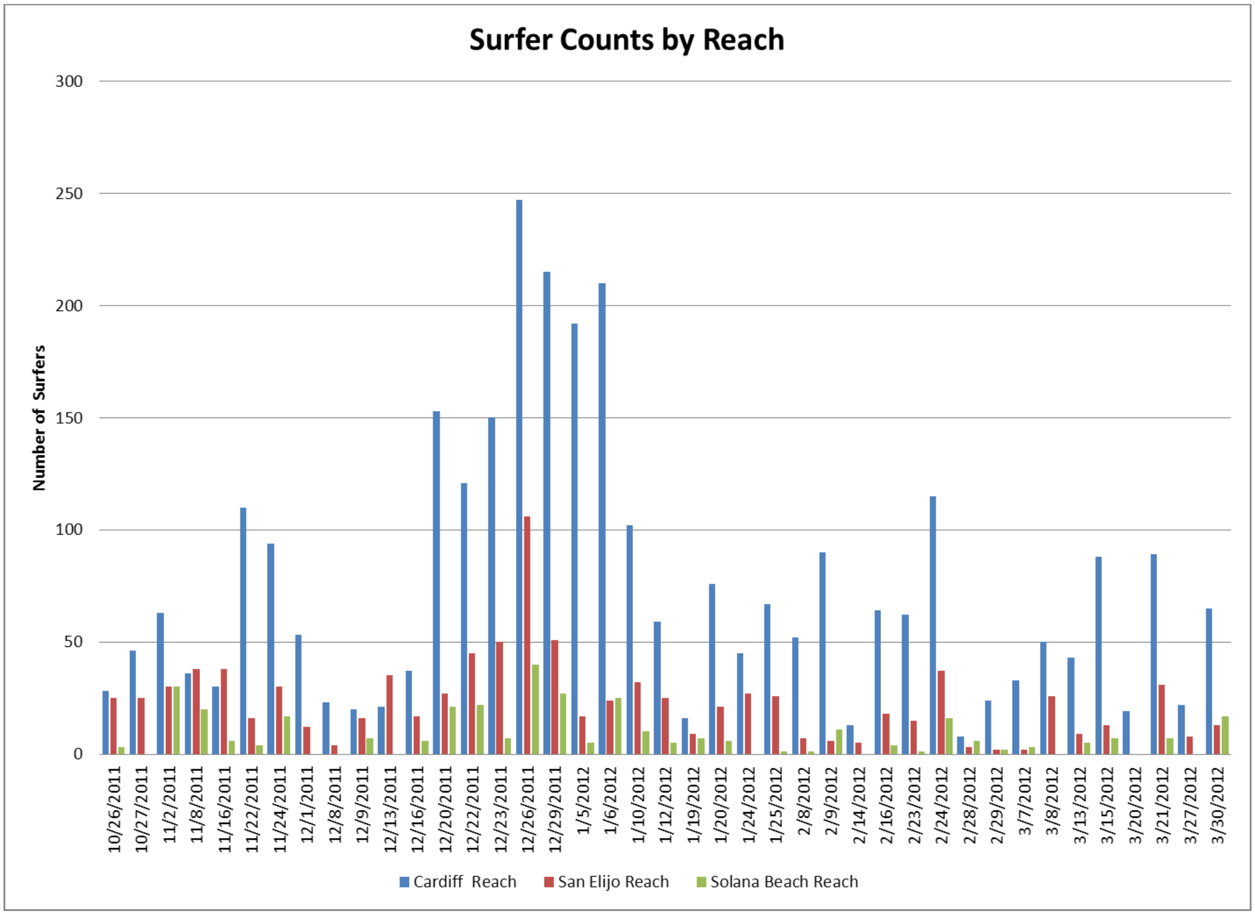


Figure 6-5: Overall Surfer Use Over the Monitoring Period

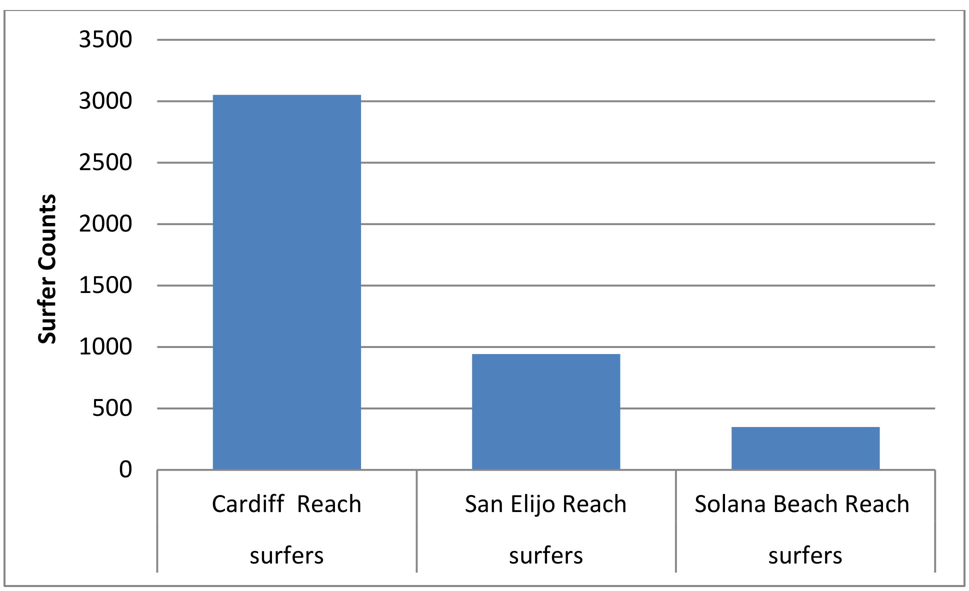


Figure 6-6: Surfer Counts Over the Monitoring Period by Reach

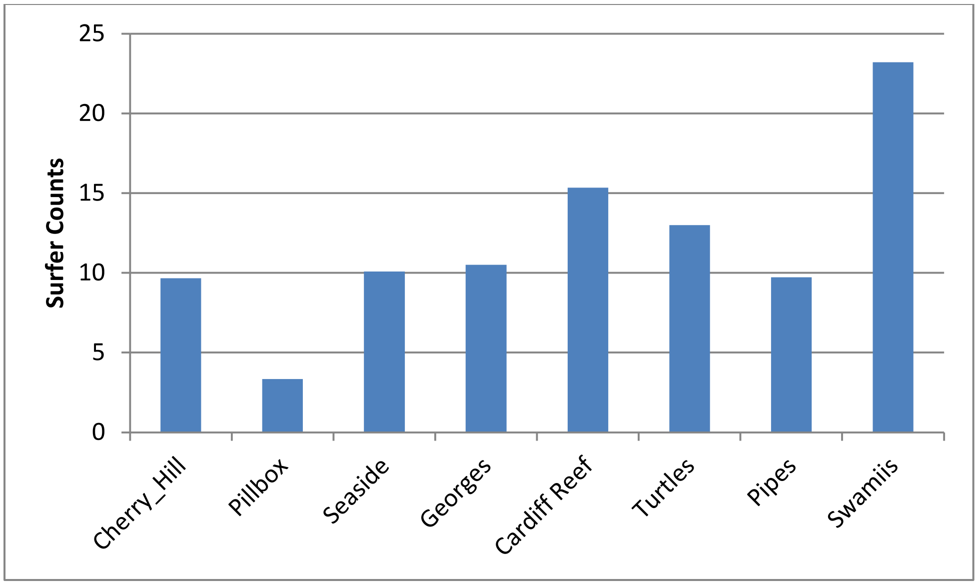


Figure 6-7: Surfer Count by Surf Break on an Average to Good Day

6.4.3 Wave Conditions

The study also included documenting wave conditions at each site during each observation. The data collection form is shown in Appendix B.

6.4.4 Public Opinion Surveys

Finally, the study included a questionnaire of public opinion on experiences surfing within the study area. The questionnaire is shown in Appendix C. Results show the expected mix of experiences and tastes. The clear conclusion is that surfing is a high priority resource to the public within each reach.

7. ANALYSES

The purpose of the analyses will be to evaluate some of the potential impacts of these Project components on surfing resources in the vicinity of the Project area. Analytical models will be used to perform this work for a range of existing conditions and Project alternatives. The proposed tasks to accomplish this work are summarized below.

7.1 METHODOLOGY

Conducting the surfing study analyses involved the methods described below. Methods consisted of quantitative and qualitative analyses. The study was supplemented by site visits to each surf spot, surfing each spot, and meeting and interviewing stakeholders and old-time locals to learn more about the spots.

7.1.1 Quantitative Analyses

Quantitative analyses were performed for various surfing parameters, and methods recently developed for the USACE Encinitas and Solana Beach Shoreline Protection Project (USACE 2012). For the three project material re-use scenarios (II, III, and IV), project-induced changes were analyzed for each surf site for the following parameters:

- wave backwash;
- wave breaking intensity;
- reef burial;
- wave breaker location;
- peel angle;
- ride length;
- surfer type (e.g., beginner, advanced, shortboard, longboard); and
- wave breaking frequency.

Sub-tasks within the analyses included:

1. Creating a surf site database within the Project impact area between Torrey Pines and Batiquitos Lagoon using published information, recent studies, grey literature, and information gained from the site visit. Primary emphasis was on analyzing the reach from Swami’s to Cherry Hill because more sand is proposed for placement in that area than in other areas. Reaches beyond this area were analyzed in less detail due to less sand being proposed for placement.

2. Calculating short-term changes in backwash coming from the constructed beach berm for surf sites fronting beach nourishment sites.
3. Calculating changes to wave breaking intensity derived from changes in grain sizes resulting from the Project for beach breaks within the Project impact area.
4. Calculating changes in backwash resulting from changes in grain sizes resulting from the Project for beach breaks within the Project impact area.
5. Calculating Project-induced burial for the reefs within the Project impact area. Key inputs to this analysis were Project-induced sand thickness changes developed from GENESIS model results.

7.1.2 Qualitative Analyses

Qualitative analyses pertain to changes in surfing near tidal inlets that may occur from restoration. These analyses rely on historic anecdotal evidence and interviews with locals. Specific examples of possible changes in the Cardiff and George's surf breaks from changes in the lagoon mouth associated with restoration alternatives include:

- A closed existing lagoon mouth from Alternative 2A – Impacts could be caused by reduced tidal flow, lack of scour along reef edge, and any adverse effects on bathymetry; and
- An open existing lagoon mouth from Alternatives 1A and 1B – Impacts could be caused by current/wave interaction.

Another analysis can include documentation of effects to surfing at existing and new inlets associated with restoration projects such as Batiquitos Lagoon, Bolsa Chica Wetlands, Huntington Beach Wetlands, and San Dieguito Lagoon.

7.2 QUANTITATIVE IMPACTS

Results of all analyses are presented below.

7.2.1 Construction Impacts

(a) Backwash

The beach profile can be expected to differ from a natural shape immediately after construction of the beach nourishments. Changes in beach profile can induce backwash, which is commonly understood to negatively impact surfing. Backwash is frequently developed as waves reflect off a steep beach, bluff face, or seawall. Beach profiles built during construction are expected to be short lived, evolving to equilibrium profiles within six months after construction.

When estimating project-induced changes to post construction backwash it is useful to review empirical data from previous projects. For Regional Beach Sand Project I (RBSP I), beach profiles at fill sites were designed to be built with a somewhat steep 10:1 (run/rise) slope. Within four months after construction, post-construction beach slopes low in the profile (during low tides) tended to be mild due to a nearshore bar, and they tended to be steep higher in the profile (during high tides) as compared to the long-term average fall beach slope. Calculating backwash from these slopes, it was found that during low tides, the post construction backwash was either the same or less than the long-term average. During high tides, the post construction backwash was found to be either the same or higher than the long-term average. Measuring beach slopes across the entire beach averages out these differences, resulting in negligible changes in beach slopes and backwash. To estimate the worst case changes, the design and post-construction change in backwash from the long-term condition is quantified in the following paragraphs during a high tide condition.

As previously mentioned, backwash during low tides should be less than average due to the lower relative water level. As shown in Figure 7-1, this is evidenced by a milder October 2001 slope extending seaward from MLLW than for the average fall profile at SD-600 in Solana Beach (Fletcher Cove). This milder post-construction nearshore slope was also found at other profile locations.

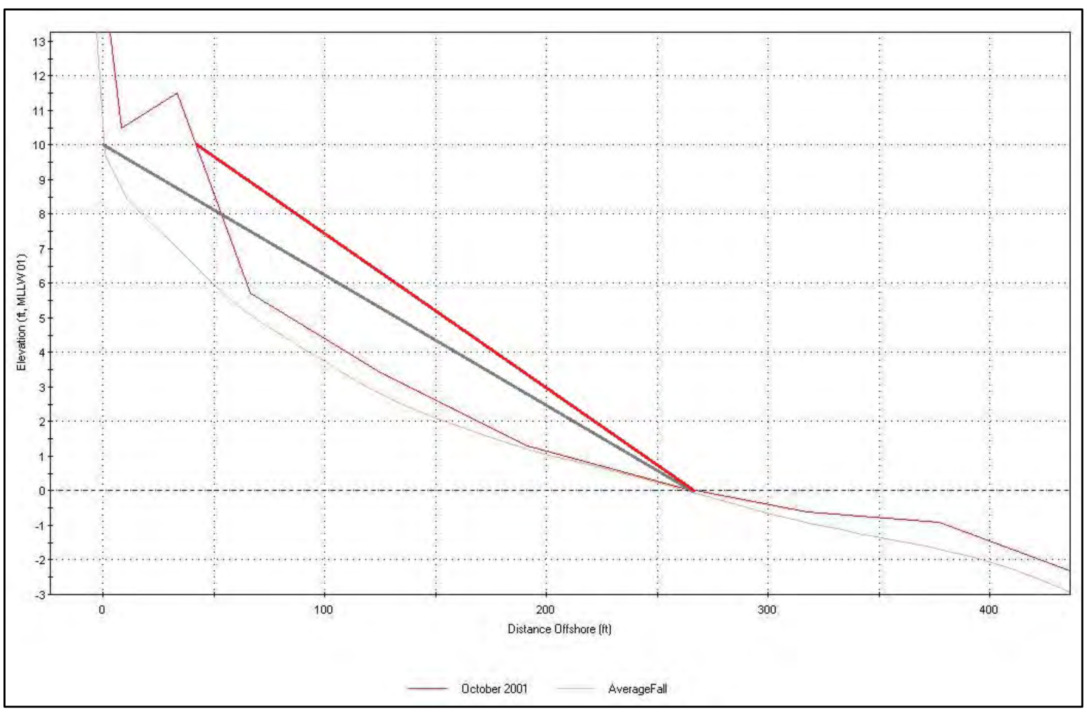


Figure 7-1: Select Profiles at SD-600

The nourishment sand used in the RBSPI was from offshore borrow pits and had median grain sizes slightly larger than the receiving beaches. The disposal grain sizes from the SELRP are smaller than those used in RBSPI and RBSPII, so any beach berms constructed for the SELRP can be expected to have milder constructed and equilibrium slopes than those found in RBSPI or RBSPII. Using empirical evidence of beach slopes and backwash estimates from RBSPI is conservative in that slopes and backwash expected from the SELRP are expected to be milder. RBSPII data was unavailable at the time of this analysis.

Wave backwash was calculated for the two beach fill sites fronting surf sites (George's and Fletcher Cove). Backwash was calculated using the proxy term "reflection," commonly used in coastal engineering. The degree of wave reflection is defined by the reflection coefficient, $C_r=H_r/H_i$, where H_r and H_i are the reflected and incident wave heights, respectively. Changes in backwash intensity can be estimated by changes in the reflection coefficient as defined by the USACE (2002):

$$C_r= a\xi_o^2/(b+ \xi_o^2) \quad \text{(Equation 1)}$$

Where a=0.5, b=5.5, and ξ_o is the surf similarity parameter at the structure face. The surf similarity parameter is calculated as:

$$\xi_o = \tan \beta/(H_o/L_0)^{½} \quad \text{(Equation 2)}$$

Where β is the angle of the seabed slope (tan β=rise/run), H_o is the deep water wave height, and L_0 is the deep water wave length as described by $L_0 = gT^2/2\pi$, g is the acceleration due to gravity and T is the wave period. Combining terms results in:

$$C_r = 0.5L_o/[H_o\, m^2(5.5+L_o/(H_o m^2))]. \quad \text{(Equation 3)}$$

Where m is the horizontal component of the beach slope (run/rise).

Beach slopes were estimated from beach profile survey data between elevations of +10 ft MLLW down to 0 ft MLLW. A uniform elevation was chosen for the top of the beach berm at 10 ft, MLLW for consistency of method. This is below the plateau of most beach berms in the project area, but high enough to capture most wave runup and backwash. The bottom of the range was chosen as 0 ft, MLLW since this is a common location for the bottom of the dry beach and the lower limit of the swash zone. Reflection coefficients were calculated from these beach slopes using Equation 3. Goda (2000) reports reflection coefficients for natural beaches ranging from 0.05 to 0.2 and the *Shore Protection Manual* (USACE 1984) reports reflection coefficients for beaches ranging from 0.01 to 0.45. Design beach slopes, measured beach slopes and calculated reflection coefficients during and after construction of the RBSPI were assumed to be similar to what will be expected during and several months after construction of the SELRP. An example calculation of this backwash is provided below for one surf site.

To solve the surf similarity parameter in Equation 2 and 3, the long-term average wave conditions were developed as follows. The Del Mar wave gage (#051) was assumed to be indicative of wave conditions along the study area. This gage is located in 30 feet of water (CDIP 2012). The average long-term conditions were calculated by averaging the annual average wave conditions for this gage with the significant wave height being 3.0 feet and the peak wave period being 11.8 seconds. The following parameters were calculated using the ACES/CEDAS (Veri-Tech 2008) software assuming straight and parallel bottom contours:

- deep water significant wave height is 2.87 feet,
- deep water wave length is 707 feet,
- breaking wave height is 5.9 ft (assuming 40:1 slope),
- breaking wave depth is 6.3 feet, and
- wavelength at breaking is 166 feet.

Beach construction is assumed to occur at any point in time during the year. As such, empirical data from Fall surveys before and after the RBSPI project were used to draw conclusions. Fall and Spring beach profiles are expected to be different, but the assumption is that general trends and differences between pre- and post-construction profiles should be maintained, regardless of which season construction occurs. The long-term average fall beach profile (Average Fall) and slope are shown in Figure 7-1 for profile location SD-600, which runs through the Fletcher Cove beach fill site. The average Fall profile contains all measured Fall profiles, except October 2001. At this location, the average Fall beach slope was 27:1 (run/rise) as shown with a grey line. Also shown in Figure 7-1 are the post-construction beach profile (October 2001) and slope measured after the RBSPI (red line). The RBSPI nourishment at this site ended on June 24, 2001 and the post-construction profile occurred in October of that year, thus there was a 4 month interval between construction and profile measurement. The design beach slope was 10:1 (SANDAG 2000) and the post-construction beach slope from Figure 7-1 is 23:1. The calculated reflection coefficient changed from an average Fall value of 0.03, to a design value of 0.15, and a post-construction value of 0.04. In other words the long-term average Fall backwash during high tides was approximately 3 percent. This increased to 15 percent during and immediately after construction, and dropped back to 4 percent within 4 months after construction. These values are summarized in Table 7-1.

Table 7-1 shows beach slopes and reflection coefficients for average Fall, design, and post-construction conditions for profiles that occurred at RBSPI fill sites. These are fill sites for the current SELRP and are known surf sites. Only RBSPI fill sites showed steep beach slopes after construction. Beach slopes upcoast and downcoast from RBSPI fill sites remained relatively unchanged by the construction of beach nourishment. This is assumed to be the case for the

SELRP as well, so surf sites upcoast and downcoast of the fill sites are assumed to not be changed in this way.

Table 7-1: Beach Slopes and Reflection Coefficients

Surf Sites	Profile	Beach Fill Site	Beach Slope, m			Reflection Coefficient, C_r		
			Avg Fall	Design	Post Const	Avg Fall	Design	Post Const
Georges	SD-630	Cardiff	24	10	13	0.04	0.15	0.07
Fletcher Cove Beach	SD-600	Fletcher Cove	27	10	23	0.03	0.15	0.04

All the surf sites within the SELRP fill footprints can expect to have increased backwash during high tide immediately during and after construction due to the increased steepness of the design berm. Changes in high tide, post-construction backwash are expected to be negligible at surf sites away from the fill sites.

If the beach nourishment is built to the design slope of 10:1 then Georges can expect to have a constructed, high tide, increase in backwash of approximately 11 percent (i.e., the backwash would increase from 4 to 15 percent) during each nourishment construction episode. Immediately after construction, the beach slope and backwash will start to become milder. By approximately 4 months after construction the increase in backwash during high tide is expected to be approximately 3 percent. By 6 months after construction, any Project-induced signal in the beach profile slopes would be lost in the seasonal profile changes, which are much greater than those calculated in Table 7-1. These post-construction changes are expected to occur after each nourishment interval. Fletcher Cove can expect a similar one-time increase in backwash of approximately 12 percent during construction, and an increase of 1 percent lasting for 4 months after nourishment.

Any short term Project-induced surfing impacts due to construction of the beach berm should be weighed against potential beneficial impacts resulting from the construction of the ebb bar. As discussed in Section 7.3.4 of this report, the ebb bar is expected to significantly improve surfing resources near Georges.

(b) Direct Burial

The fill site in Imperial Beach for the RBSPII was built out into the surf zone with 450,000 cy of sand. This was identified to have negatively temporarily impacted surfing in that area for 3.5 months. This fill volume was large for the available fill site length, thus the as-built beach width was 250 feet wider than the pre-project beach, much wider than other fill sites within RBSP II or the current SELRP. No similar volumes or design beach widths are proposed for the SELRP. In fact, the widest SELRP beach width is proposed to be 150 feet. Thus, no direct burial of surf sites is expected from the Project.

7.2.2 Impacts from Modified Grain Size and Nearshore Slope

It is possible to calculate long-term changes in backwash, wave breaking intensity, and wave vortex ratio from changes in sediment grain sizes in the surf zone. This has recently been performed by the USACE (2012) for another project near the Project area. Since the sediment grain sizes to be disposed under the current Project are equal to the existing grain sizes within the littoral zone, no long-term changes in backwash, wave breaking intensity, and wave vortex ratio are expected.

7.2.3 Sedimentation Impacts at Reef Breaks

Adding sand to the vicinity of reef breaks has the potential to make them behave more like beach breaks. Beach breaks are not included in this analysis since adding more sand on top of beach breaks does not change them significantly. The most common surfing impact expected as a result of changing reef breaks to more beach break-like conditions would be reduced peel angles, reduced section lengths, reduced ride times, and increased close outs, especially during larger swells.

Many of the surf sites in the study area neither break like pure reef breaks nor pure beach breaks, but rather somewhere on a scale between the two. Where the local breaks lie on that scale depends on the time of year, breaking wave height, swell combination, swell direction, sand coverage, tide, and surfer perception. For example, Fletcher Cove is mostly a beach break, but during large winter swells it can break more like a reef break either due to waves refracting and breaking over the reef or simply from waves refracting over the reef and breaking over the sandy beach. Changes in sand elevation can change the extent to which any reef behaves like a reef break, whether or not the reef is entirely covered, partially covered, or its vertical elevation contrast (relief) simply lowered relative to the surrounding sandy seafloor. Raising the sandy seafloor surrounding a reef reduces the relief between the reef and sandy seafloor. This results in less refraction shoaling at the reef and less definition to the surf site. So any change in the sand thickness surrounding a reef could potentially change how that surf site breaks.

There are at least three ways to analyze Project induced changes to these reef surf sites described as follows:

1. Detailed wave modeling would require multiple sets of bathymetric data, wave data, and surf observations, ideally measured while the surf sites were behaving like beach breaks and while they were behaving like reef breaks. This would allow for

development of a graded scale upon which the sand thickness changes could be applied to determine extent of change. However, this level of data does not exist.

2. Lacking this data, numerical modeling could be performed driven by one bathymetric data set and a broad group of assumptions about how and when the surf site behaves in different ways and what bathymetric and wave conditions drive those breaks. Due to the assumptions, the level of confidence for this type of analysis would be low.
3. A conservative, subjective scale based on quantitative data could be developed to compare Project-induced changes to profile volumes to the natural variability of the profile volumes. Profile volumes are used as a simple proxy for more detailed analysis of variable cross shore sand thickness (for which there is no quantitative guidance either). This approach was chosen for the current analysis.

Two key variables were developed to carry out this analysis: 1) the increase in profile volume resulting from beach nourishment within a given duration, and 2) the standard deviation of the historical profile volume changes. These variables and their comparison are described in detail below.

The maximum predicted change in shoreline position (ΔSL) at the model cell nearest to each reef break, within the first 5 years after construction, was extracted from the GENESIS shoreline results. The GENESIS numerical model was used to estimate Project induced changes to beach widths as described by Everest (2013) and Moffatt & Nichol (2013). These shoreline changes were converted to changes in profile volumes (V_{SL}) using the V/S ratio developed for this project and described in the shoreline analysis report by Everest (2013). Values were calculated for various combinations of wave climate and Project Scenario. Since Alternative 2A was shown in the shoreline morphology report (Everest 2013) to have the greatest changes to shoreline position, only this alternative was analyzed. It was assumed that other alternatives would cause less impacts to reef breaks.

These V_{SL} values were compared to the standard deviation of measured profile volumes nearest to each reef beak (STDEV).

For the current study, the assumed threshold for change is an increase in V_{SL} equal to the STDEV expressed as:

$$\frac{\mathrm{V_{SL}}}{\mathrm{STDEV}} = \begin{cases} < 1, & \text{Impact is not likely} \\ \geq 1, & \text{Potential impact} \end{cases} \qquad \text{(Equation 4)}$$

This ratio was calculated for each year after construction through year 5 as shown in Table 7-2 through Table 7-7. Year 1 represents April 1, assuming construction finished March 15. Year 2 is the same time the following year. For each year and each reef break within the Project area, the following results are shown: V_{SL}/STDEV ratio, the nearest profile (that was used to calculate STDEV), the cumulative years of impact, and if any impact is expected or not.

Table 7-2 through

Table 7-4 shows results for Alternative 2A, Scenarios II, III, and IV, respectively, under the calm wave climate. Table 7-5 through Table 7-7 shows similar results under the high wave climate.

In general, the wider the beach nourishment option and the less variability in the existing profile, the more likely that this method will predict that the SELRP will have an impact on the reef break. Changing these reef breaks to behave more like beach breaks is likely to be perceived as a negative impact on those surf sites.

Table 7-2: Impacts to Reef Breaks Under the Calm Wave Climate, Alternative 2A, Scenario II

Surf Site	Nearest Profile	V_{SL}/ STDEV					Impact Duration	Reef Impact
		Yr1	Yr2	Yr3	Yr4	Yr5	(Years)	
Swamis	SD660	0.0	0.5	0.7	0.8	0.8	0	not likely
Dabbers	SD660	0.0	0.2	0.5	0.7	0.6	0	not likely
Brown House	SD650	0.0	0.1	0.4	0.6	0.3	0	not likely
Pipes	SD650	0.0	0.1	0.4	0.5	0.1	0	not likely
Traps	SD650	0.0	0.1	0.4	0.5	0.1	0	not likely
Turtles & Barneys	SD650	0.0	0.2	0.4	0.4	0.0	0	not likely
85s	SD630	0.0	0.1	0.1	0.0	0.0	0	not likely
Tippers	SD630	0.1	0.2	0.1	0.0	0.1	0	not likely
Cardiff Reef R	SD630	0.3	0.2	0.0	0.0	0.5	0	not likely
Seaside Reef	SD630	0.3	0.4	0.2	0.0	0.2	0	not likely
Table Tops	SD610	0.5	1.0	0.8	0.4	0.3	0	not likely
Pillbox & Southside	SD600	1.6	1.4	1.4	1.3	0.9	4	potential
Cherry Hill	SD595	2.8	1.8	1.7	1.7	1.6	5	potential
Rockpile	SD595	1.6	1.5	1.4	1.4	1.5	5	potential

Table 7-3: Impacts to Reef Breaks Under the Calm Wave Climate, Alternative 2A, Scenario III

Surf Site	Nearest Profile	V_{SL}/ STDEV					Impact Duration	Reef Impact
		Yr1	Yr2	Yr3	Yr4	Yr5	(Years)	
Swamis	SD660	0.0	0.0	0.0	0.1	0.1	0	not likely
Dabbers	SD660	0.0	0.0	0.1	0.2	0.1	0	not likely
Brown House	SD650	0.0	0.0	0.2	0.3	0.0	0	not likely
Pipes	SD650	0.0	0.2	0.3	0.3	0.0	0	not likely
Traps	SD650	0.0	0.2	0.3	0.3	0.0	0	not likely
Turtles & Barneys	SD650	0.0	0.3	0.4	0.3	0.0	0	not likely
85s	SD630	0.0	0.1	0.1	0.0	0.0	0	not likely
Tippers	SD630	0.1	0.2	0.1	0.0	0.1	0	not likely
Cardiff Reef R	SD630	0.3	0.2	0.0	0.0	0.5	0	not likely
Seaside Reef	SD630	0.3	0.3	0.1	0.0	0.1	0	not likely
Table Tops	SD610	0.3	0.6	0.4	0.0	0.0	0	not likely
Pillbox & Southside	SD600	0.0	0.2	0.4	0.4	0.1	0	not likely
Cherry Hill	SD595	0.0	0.0	0.2	0.4	0.3	0	not likely
Rockpile	SD595	0.0	0.0	0.0	0.2	0.3	0	not likely

Table 7-4: Impacts to Reef Breaks Under the Calm Wave Climate, Alternative 2A, Scenario IV

Surf Site	Nearest Profile	V_{SL}/STDEV					Impact Duration	Reef Impact
		Yr1	Yr2	Yr3	Yr4	Yr5	(Years)	
Swamis	SD660	0.0	0.5	0.7	0.8	0.8	0	not likely
Dabbers	SD660	0.0	0.2	0.5	0.7	0.6	0	not likely
Brown House	SD650	0.0	0.1	0.4	0.6	0.3	0	not likely
Pipes	SD650	0.0	0.1	0.4	0.5	0.2	0	not likely
Traps	SD650	0.0	0.1	0.4	0.5	0.1	0	not likely
Turtles & Barneys	SD650	0.0	0.2	0.4	0.4	0.0	0	not likely
85s	SD630	0.0	0.1	0.1	0.0	0.0	0	not likely
Tippers	SD630	0.1	0.2	0.1	0.0	0.1	0	not likely
Cardiff Reef R	SD630	0.3	0.2	0.0	0.0	0.5	0	not likely
Seaside Reef	SD630	0.3	0.4	0.2	0.0	0.2	0	not likely
Table Tops	SD610	0.5	1.0	0.8	0.4	0.3	0	not likely
Pillbox & Southside	SD600	1.6	1.4	1.4	1.3	0.9	4	potential
Cherry Hill	SD595	2.8	1.8	1.7	1.7	1.6	5	potential
Rockpile	SD595	1.6	1.5	1.4	1.4	1.5	5	potential

Table 7-5: Impacts to Reef Breaks Under the High Wave Climate, Alternative 2A, Scenario II

Surf Site	Nearest Profile	V_{SL}/STDEV					Impact Duration (Years)	Reef Impact
		Yr1	Yr2	Yr3	Yr4	Yr5		
Swamis	SD660	0.1	0.6	0.8	0.8	0.8	0	not likely
Dabbers	SD660	0.0	0.4	0.6	0.8	0.7	0	not likely
Brown House	SD650	0.0	0.2	0.5	0.6	0.4	0	not likely
Pipes	SD650	0.0	0.2	0.5	0.6	0.3	0	not likely
Traps	SD650	0.0	0.2	0.5	0.5	0.2	0	not likely
Turtles & Barneys	SD650	0.0	0.3	0.5	0.4	0.2	0	not likely
85s	SD630	0.1	0.1	0.1	0.0	0.1	0	not likely
Tippers	SD630	0.1	0.1	0.1	0.0	0.1	0	not likely
Cardiff Reef R	SD630	0.4	0.2	0.0	0.0	0.4	0	not likely
Seaside Reef	SD630	0.4	0.3	0.2	0.0	0.2	0	not likely
Table Tops	SD610	0.7	1.0	0.7	0.3	0.4	0	not likely
Pillbox & Southside	SD600	1.5	1.4	1.3	1.1	0.7	4	potential
Cherry Hill	SD595	2.5	1.7	1.7	1.6	1.4	5	potential
Rockpile	SD595	1.7	1.4	1.4	1.4	1.3	5	potential

Table 7-6: Impacts to Reef Breaks Under the High Wave Climate, Alternative 2A, Scenario III

Surf Site	Nearest Profile	V_{SL}/STDEV					Impact Duration (Years)	Reef Impact
		Yr1	Yr2	Yr3	Yr4	Yr5		
Swamis	SD660	0.0	0.0	0.1	0.2	0.1	0	not likely
Dabbers	SD660	0.0	0.0	0.1	0.2	0.1	0	not likely
Brown House	SD650	0.0	0.1	0.2	0.3	0.0	0	not likely
Pipes	SD650	0.0	0.2	0.3	0.3	0.0	0	not likely
Traps	SD650	0.0	0.2	0.3	0.3	0.0	0	not likely
Turtles & Barneys	SD650	0.0	0.3	0.4	0.2	0.0	0	not likely
85s	SD630	0.1	0.1	0.1	0.0	0.1	0	not likely
Tippers	SD630	0.1	0.2	0.1	0.0	0.1	0	not likely
Cardiff Reef R	SD630	0.4	0.2	0.0	0.0	0.4	0	not likely
Seaside Reef	SD630	0.3	0.2	0.1	0.0	0.1	0	not likely
Table Tops	SD610	0.4	0.6	0.3	0.0	0.0	0	not likely
Pillbox, Southside	SD600	0.0	0.3	0.4	0.3	0.0	0	not likely
Cherry Hill	SD595	0.0	0.1	0.3	0.4	0.3	0	not likely
Rockpile	SD595	0.0	0.0	0.1	0.3	0.3	0	not likely

Table 7-7: Impacts to Reef Breaks Under the High Wave Climate, Alternative 2A, Scenario IV

Surf Site	Nearest Profile	V_{SL}/STDEV					Impact Duration	Reef Impact
		Yr1	Yr2	Yr3	Yr4	Yr5	(Years)	
Swamis	SD660	0.1	0.6	0.8	0.9	0.8	0	not likely
Dabbers	SD660	0.0	0.4	0.6	0.8	0.7	0	not likely
Brown House	SD650	0.0	0.2	0.5	0.7	0.4	0	not likely
Pipes	SD650	0.0	0.2	0.5	0.6	0.3	0	not likely
Traps	SD650	0.0	0.2	0.5	0.5	0.2	0	not likely
Turtles & Barneys	SD650	0.0	0.3	0.5	0.4	0.2	0	not likely
85s	SD630	0.1	0.1	0.1	0.0	0.1	0	not likely
Tippers	SD630	0.1	0.1	0.1	0.0	0.1	0	not likely
Cardiff Reef R	SD630	0.4	0.2	0.0	0.0	0.4	0	not likely
Seaside Reef	SD630	0.4	0.3	0.2	0.0	0.2	0	not likely
Table Tops	SD610	0.7	1.0	0.7	0.3	0.4	0	not likely
Pillbox & Southside	SD600	1.5	1.4	1.3	1.1	0.7	4	potential
Cherry Hill	SD595	2.5	1.7	1.7	1.6	1.4	5	potential
Rockpile	SD595	1.7	1.4	1.4	1.4	1.3	5	potential

Observations indicate that reef breaks in Solana Beach at Pill Box, Southside, Cherry Hill, and Rockpile are offshore reef breaks that breakless frequently than other nearby sites. Most of the time they behave like beach breaks with waves shoaling in shallower sand-covered bottom areas close to shore. Therefore, the potential impact identified above for Scenarios II and IV may be of a lesser magnitude than the matrix suggests. An interview with long-time Solana Beach local Ira Opper indicated that sand deposition on the vicinity of these sites from previous nourishment by the San Diego Association of Governments (SANDAG) in 2001 produced good quality surf for a relatively short time period (Opper, Personal Communication 2012 and 2013). The sand quantity placed in 2001 at Fletcher Cove in Solana Beach is the same quantity proposed for this SELRP at 146,000 cy, and the sand is of similar quality as being relatively fine-grained. The same interview source indicates that Pill Box experienced poor conditions in 2012/2013 after sand was placed at Solana Beach in 2012 by SANDAG. This sand was much coarser in grain size than the previous project and may have deposited differently than finer sand. Considering these anecdotal data, sand from the SELRP may not cause a significant adverse impact to surfing at Solana Beach. However, the effects should be monitored and any adverse impacts identified if they occur.

7.2.4 Currents at Surf Sites

Ocean currents can change surfing by changing a surfer's ability to line up for and catch a wave and by changing the way waves break. The most frequent currents around these North County surf sites are rip currents and ebb and flood tidal currents near San Elijo Lagoon. Some currents can also be expected near high relief reefs. All of these currents are expected to be highly variable, changing with swell, tide, and wind conditions. Potential impacts of currents are addressed in the subsequent report section of qualitative analyses.

7.2.5 Currents at Beach Breaks

As beaches widen with the Project alternatives, the break point of the surf sites are expected to move proportional distances seaward, bringing with them the various currents that exist under normal without-Project conditions. These currents are not expected to change in magnitude or direction, but only relocate seaward. Therefore, the SELRP is not expected to significantly change currents or change surfing in any discernible way through changes to currents at beach breaks.

7.2.6 Changes to Surf Break Location and Surfing Frequency

As with ocean currents, the locations of the break point of beach breaks are expected to move seaward distances that are proportional to the amount of beach widening. For example, if a beach is expected to widen by 100 feet, it can be expected that the beach break fronting that shoreline would move a similar distance seaward, maintaining an unchanged relative distance between the break point and the shoreline. The primary change to surfing locations at beach breaks is that they would move seaward relative to geographic coordinates, but not change perceptibly relative to the shoreline.

With no long-term expected changes to the surf zone seabed slope, most waves that would have been surfable prior to the SELRP would still likely be surfable under the Project condition. Exceptions are 1) during high tide during construction when a minor increase in backwash is expected and 2) at reef breaks that may experience excessive sedimentation. The above described changes to surfing quality can change the frequency of surfability as detailed in Table 7-8.

Table 7-8: Project Induced Changes to Surfing Frequency

Phenomenon	Project Induced Change	Change to Frequency of Surfability
Backwash at Beach Breaks	Increased backwash during construction	Less Frequent
Breaking intensity at Beach Breaks	No change	No change
Sedimentation of Reef breaks	Reef break to beach break	Less frequent
New Ebb Bar	New Surf Site	More frequent

Changing a surf site from a reef break to more of a beach break could reduce the surfing frequency, especially during walled conditions or windy conditions where the only surfable places tend to be reef breaks. Given that the increased backwash is expected to be an intermittent (only during high tides) and temporary impact (during and immediately after construction) and that the reefs impacted by sedimentation rarely break, and that the new ebb bar for Alternative 2A is expected to break frequently and be a permanent feature, the overall frequency of surfable waves within the study area are expected to improve as a result of the SELRP alternatives. As a note, the offshore ebb bar is not a permanent feature of Alternative 1B.

7.3 QUALITATIVE IMPACTS

These analyses address the effects of modifications to the tidal inlet from implementation of various alternatives, as compared to existing conditions.

7.3.1 Closing the Existing Inlet and Creating a New Inlet – Alternative 2A

Closure of the existing tidal inlet to create a new tidal inlet for Alternative 2A could potentially cause impacts from reduced tidal flow from the existing inlet, lack of scour along the reef edge, and potential effects on bathymetry. Each item is addressed below.

Reduced Tidal Flow – Tidal flow presently issues from the mouth of San Elijo Lagoon just south of the Cardiff Reef surf spot and north of George's. Tidal flow out of the Lagoon (ebbing tides) results in a rip current. The current velocities were modeled as part of the SELRP project hydrodynamics study (Moffatt & Nichol 2012). Model results for an ebbing spring tide show that the velocity of the current is relatively low because tidal flow "fans out" after issuing from the inlet channel into the nearshore ocean. Figure 7-2 shows the position of the ebbing tidal jet relative to Cardiff Reef for mid-tide as predicted using a numerical model. The figure shows the modeled velocity results overlaid on an aerial photograph of the coast. The model predicts currents distributed symmetrically off the inlet with flow spreading uniformly outward in an approximate 180-degree arc offshore..

Figure 7-2: Existing Inlet, Ebbing Spring Tidal Flow Velocities at High Tide

Existing conditions do not appear to include significant scour along the south edge of Cardiff Reef under normal conditions. Modeling predicts that existing ebb tidal flow velocities in the nearshore are insufficient to suspend sand from the seabed. Extreme conditions of high stormflows draining coincident with ebbing spring tides may result in scour in the beach and nearshore, but do not appear to be a controlling factor for bathymetry. Several aerial photographs from different dates when the tidal inlet was closed are provided in Figure 7-3 through Figure 7-6. The wave breaking pattern at Cardiff Reef does not appear different from dates when the tidal inlet was open, shown in Figure 7-7 and Figure 7-8. These data support the conclusion that the bathymetry of Cardiff Reef is not controlled or affected significantly by scouring from the inlet, but rather by the bedrock foundation of the reef.

In addition, the position of the ebbing current jet is typically south of the surf spot and not in direct connection with the path of the wave rider. Reducing the ebbing current by closing the inlet for Alternative 2A will not likely affect the bathymetry of Cardiff Reef and surfing.

Figure 7-3: Inlet Closed, 1972

Figure 7-4: Inlet Closed, 1986

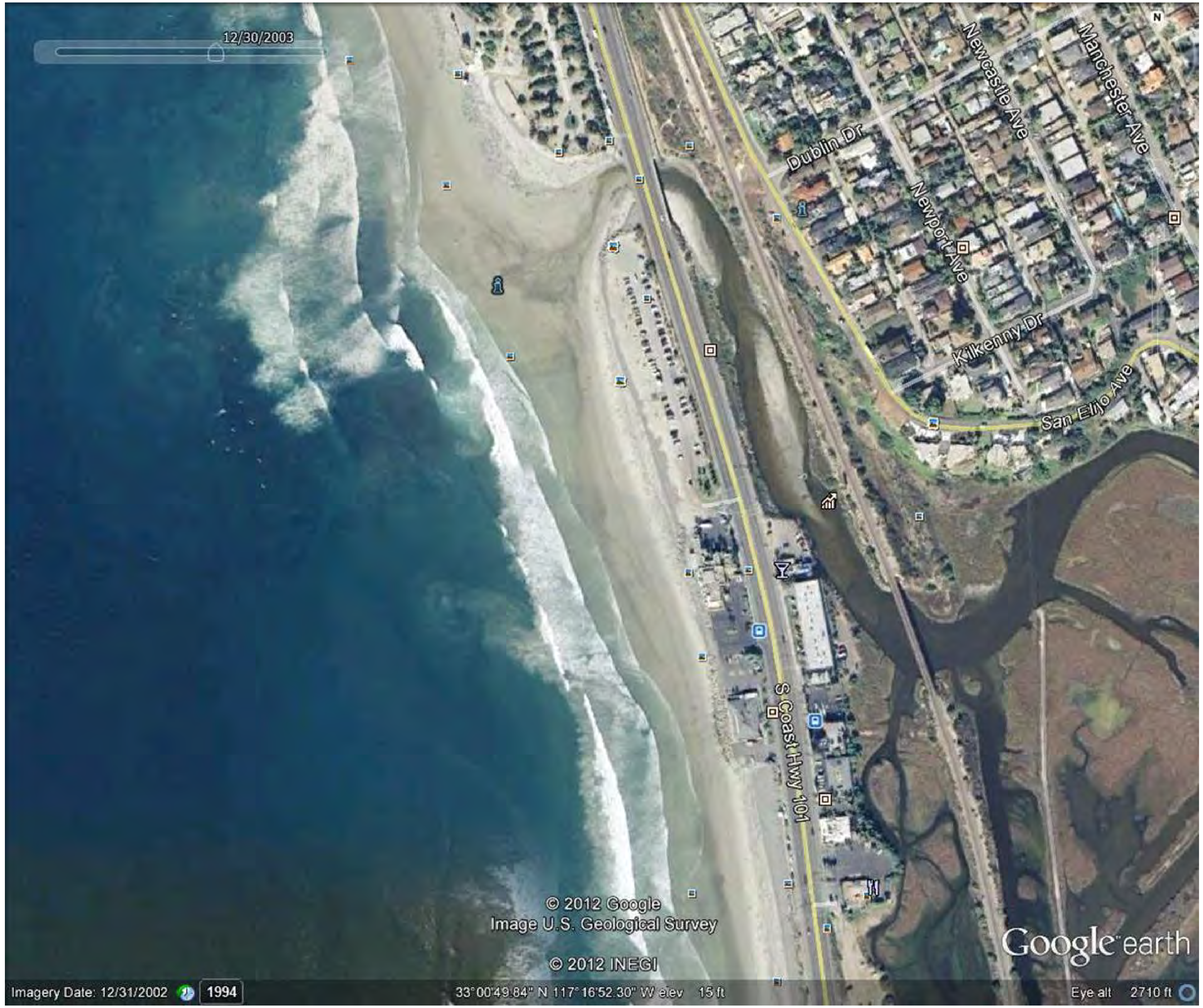


Figure 7-5: Inlet Closed, 2002

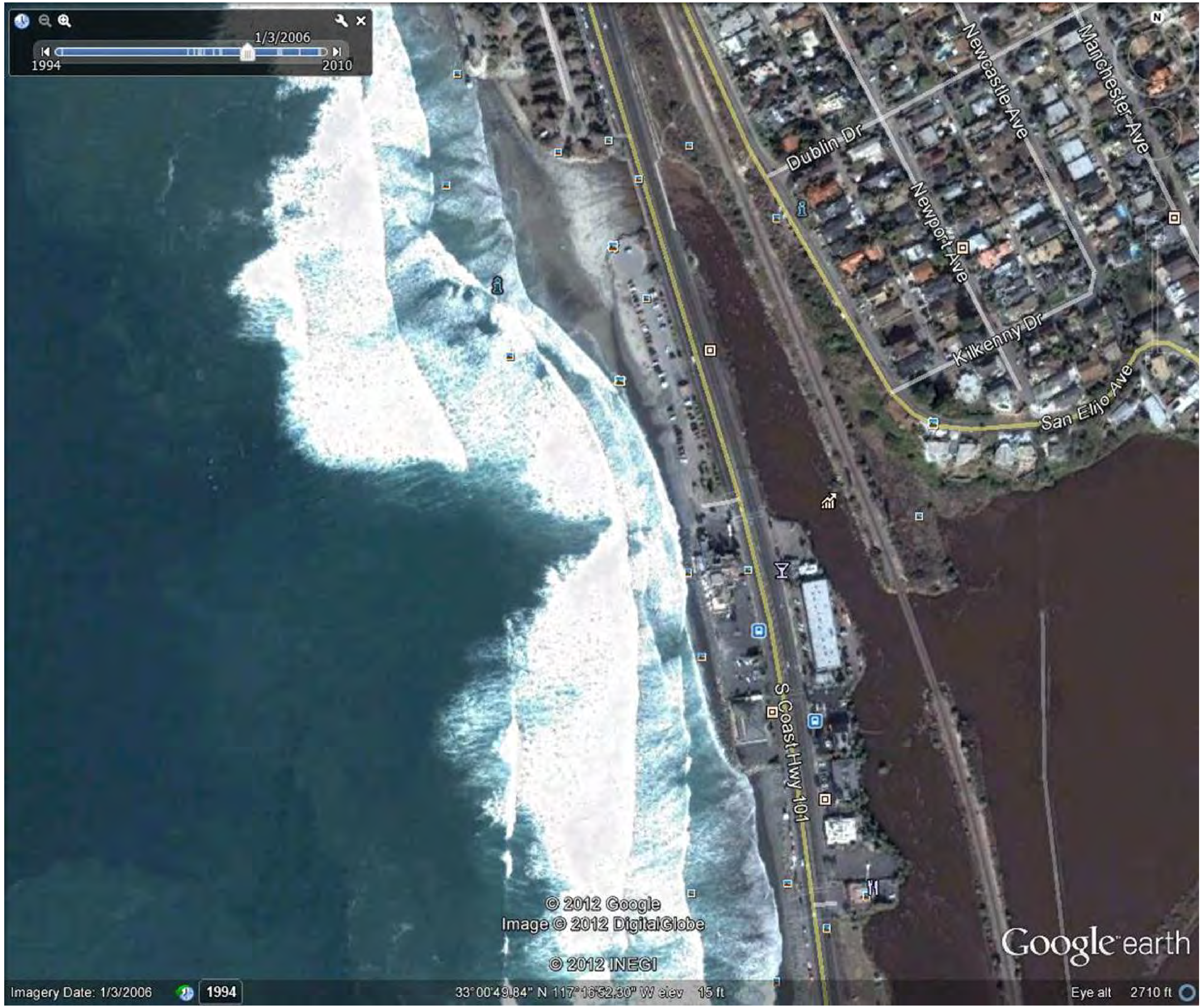


Figure 7-6: Inlet Closed, 2006

Figure 7-7: Inlet Open, 1993

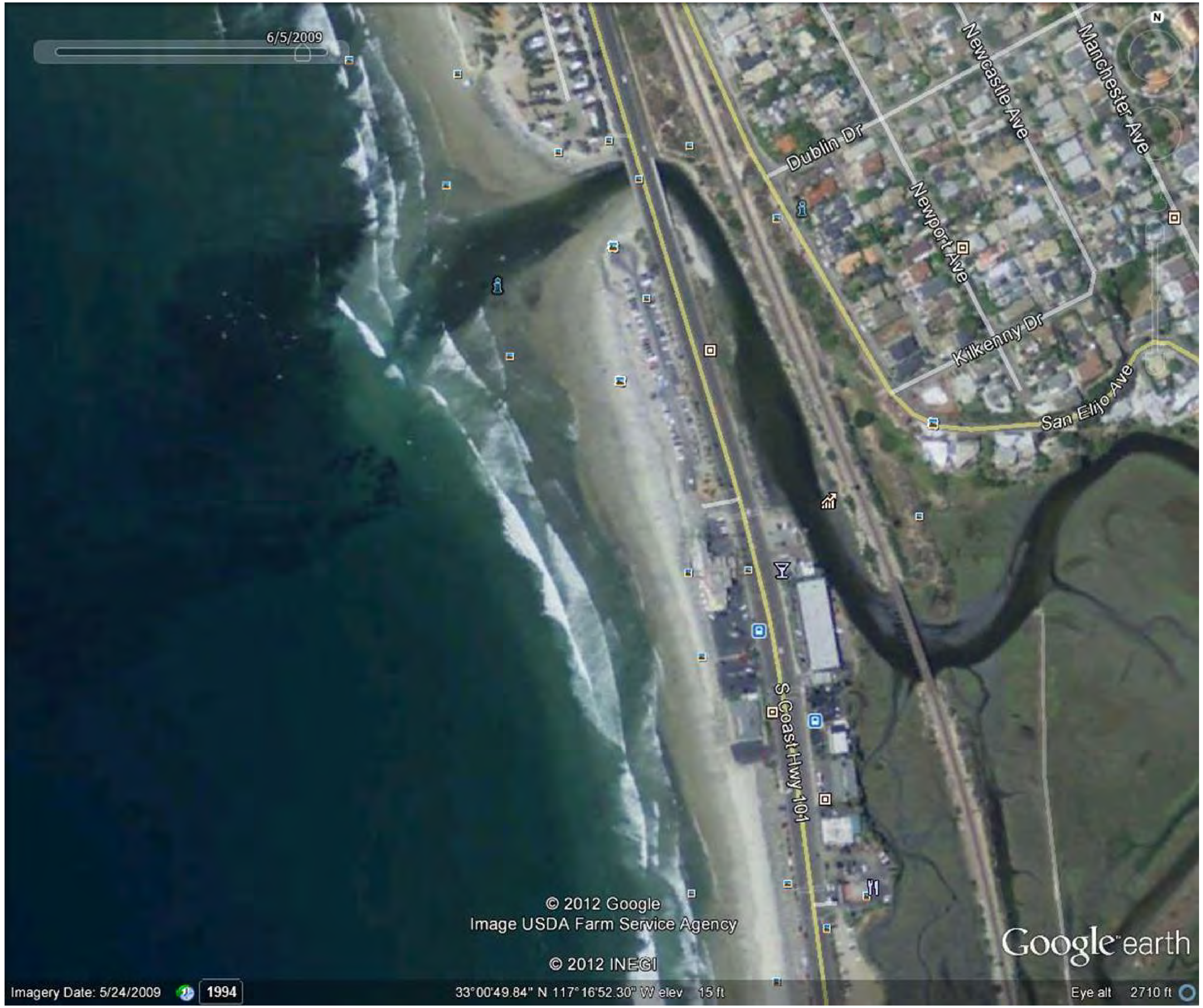


Figure 7-8: Inlet Open, 2009

7.3.2 An Existing Open Lagoon Mouth With Increased Flows – Alternatives 1A and 1B

Implementing Alternatives 1A and 1B will increase the tidal prism of the Lagoon, and the consequent tidal discharge through the tidal inlet. Impacts to surfing could be caused by current/wave interaction. Hydraulic model results were used to compare existing conditions to proposed conditions for alternatives.

Increasing the tidal discharged from the existing tidal inlet could cause increased turbulence on the ocean surface at the Cardiff Reef surf spot if the currents interacted with waves in a particular manner. If the ebbing current was directed into the wave shoulder or toward the take-off zone of the wave at Cardiff Reef, turbulence from the current interaction with the wave could cause chop on the surface and decrease the wave quality. This type of condition exists at certain inlets (e.g., Ocean Beach Jetty in San Diego) under certain spring tidal conditions and makes it more difficult to surf and can diminish the surfing experience. Observations at Cardiff Reef over time show that the ebbing current is directed more to the southwest and away from the shoulder of the right at Cardiff Reef, and current/wave. With the relative position of the ebbing current south of and away from the Cardiff Reef surf spot, increasing tidal currents should not cause a new problem with current/wave interaction. Table 7-9 shows existing tidal currents in the nearshore, and predicted currents with Alternatives 1A and 1B. The variation in tidal current velocities is relatively low and should not cause a change in the existing pattern of the ebbing tide. Therefore, it is not anticipated that either alternative would cause different current/wave interaction and a decrease in surfing wave quality or the surfing experience. Figure 7-10 shows predicted ebb tidal current velocities at Cardiff Reef.

Table 7-9: Ebbing Spring Tidal Peak Flow Velocities at Cardiff Reef for Mid-Tides As Predicted by the Hydrologic Model (in Feet Per Second)

Location	Existing Conditions – No Project	Alternative 1A Minimal Grading/Dredging – Existing Inlet	Alternative 1B – Maximum Habitat Diversity – Existing Inlet
Mid-Tide Conditions With the Wave Break Point Closer to Shore			
Beach	2.0	2.0	>2.0
Impact Zone	0.2	0.3	0.4
Line-Up	<0.2	<0.2	0.2

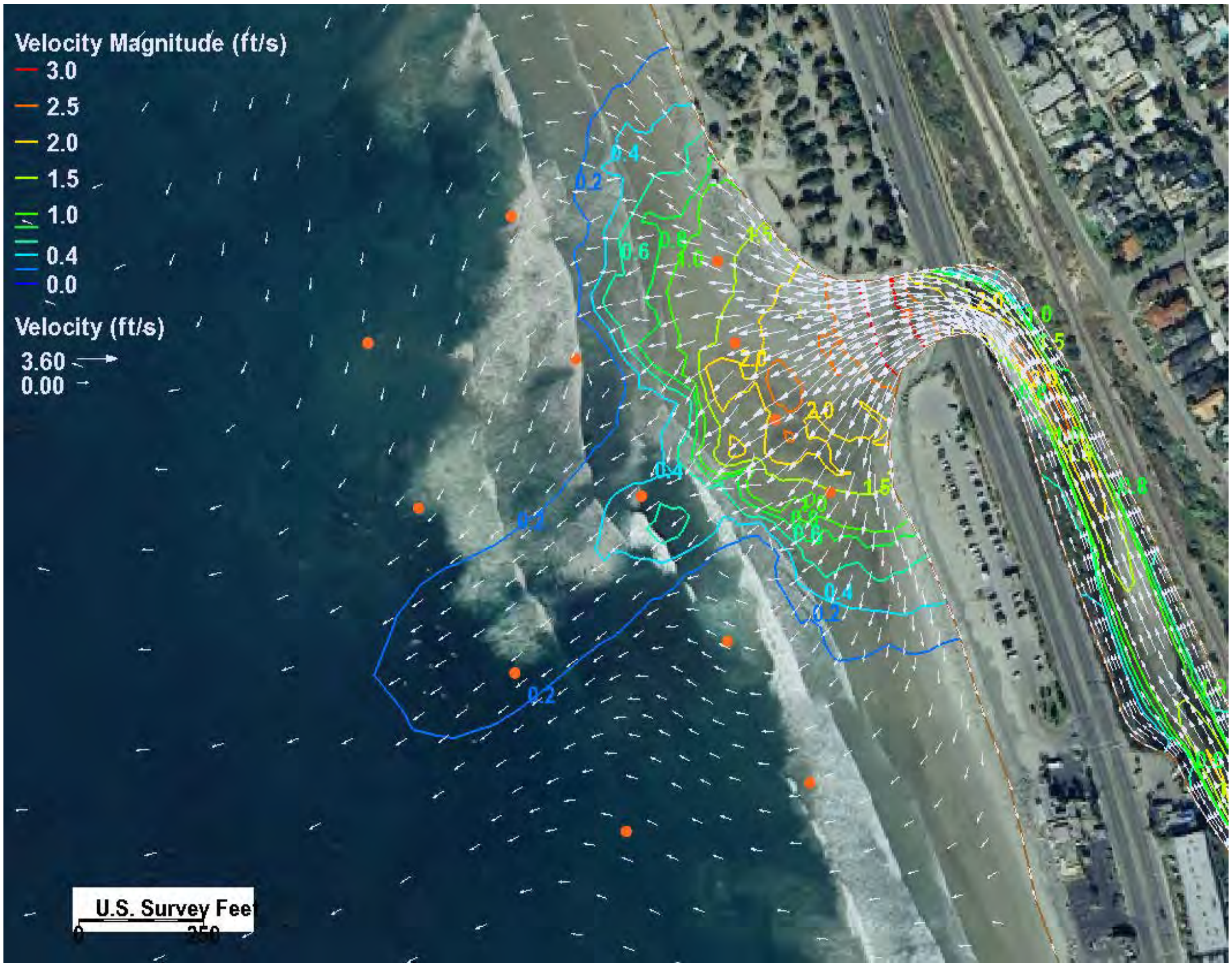


Figure 7-9: Ebb Tidal Flow Velocities at Cardiff Reef

Regardless, if Alternatives 1A or 1B move forward, monitoring of possible project effects of the ebbing tidal current on surfing at Cardiff will be required and any mitigation identified.

Although the numerical model indicates slightly increased tidal currents in the vicinity of the surf break, the effect may be reduced because the location of the ebbing tidal jet is south of the South Peak surf break. The location of the ebbing tidal jet follows the bathymetry that is deeper to the south of the South Peak. South Peak breaks over a shallower area of the reef and the breaking wave follows that bathymetry. In contrast, ebbing tidal currents seek the path of least resistance, and therefore follow the deeper bathymetric contours outside of the surf break. Site observations show that the ebbing tidal current is located off and away from the shoulder of the right that breaks off South Peak.

7.3.3 New and Relocated Lagoon Mouth– Alternative 2A

Installing a new tidal inlet relocated south of the restaurants for Alternative 2A will change the surf at George's. Surfing at George's occurs from in front of restaurant row south to the middle portion of Cardiff Beach. Alternative 2A would install a new tidal entrance through the beach south of Las Olas Restaurant, and through the southern portion of George's. Figure 7-10 shows the project inlet location relative to George's. This will significantly alter a portion of George's, but the effect may range from adverse under certain conditions, to neutral and even beneficial under other conditions.

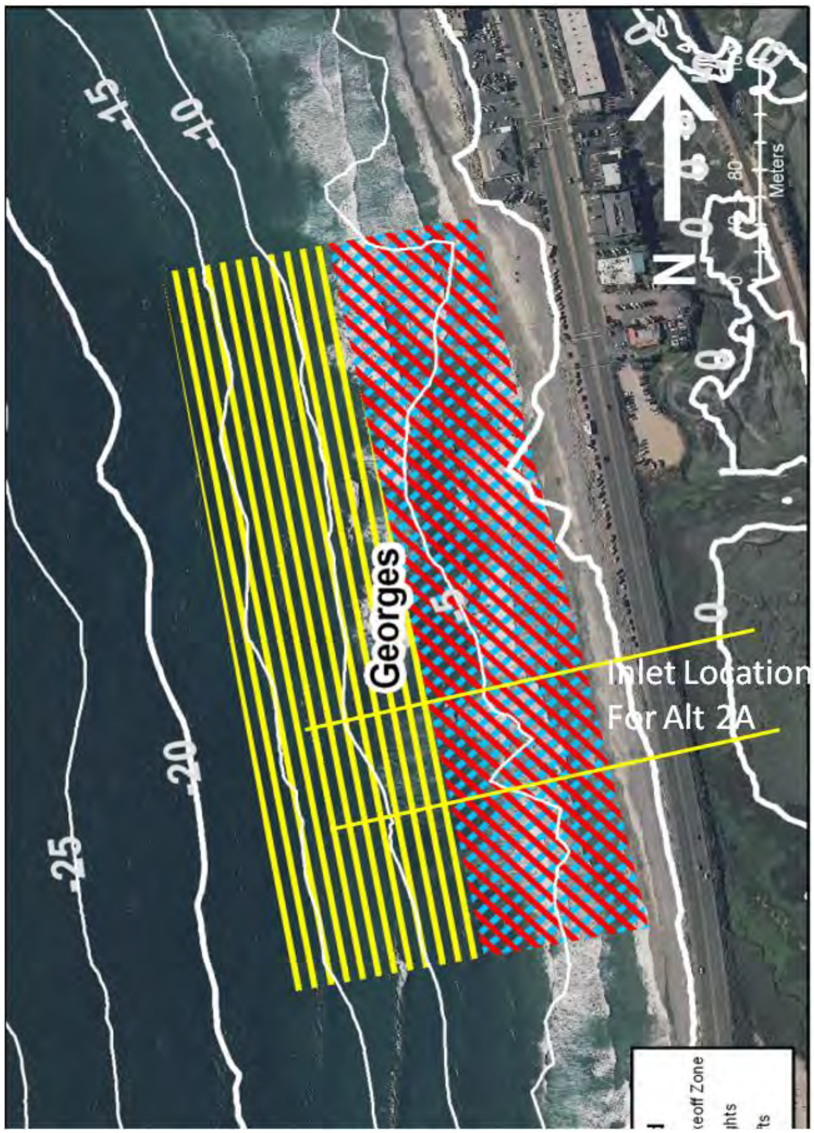


Figure 7-10: Tidal Inlet Location for Alternative 2A Relative to George's

The existing character of George's will change with the existence of a new channel, but there will not be jetties protruding into the water. Short stone Cobble Blocking Features (CBFs) are proposed on both sides of the inlet at the back of the beach (near the toe of the existing revetment slope) to partially block existing cobble from entering the inlet during winter conditions and to protect the base of the bridge abutment from direct wave attack. These structures are intended to be below the beach and landward of the water line under near all conditions, so they should be "transparent" to any effect on surfing.

The new inlet channel will extend through the surf zone as a deep spot that may provide a paddling opportunity for return trips to the line-up. The channel will breach the nearshore sand bars at George's and change existing wave breaking patterns. A larger bar will exist at the seaward end of the channel in the nearshore (the ebb bar) that may produce a ridable peak, similar to what presently exists off Batiquitos Lagoon mouth, the San Dieguito River mouth, and Bolsa Chica. Therefore, the project will create a break in the existing relatively straight-lined bathymetry along this beach and may create a rideable wave in the vicinity of the new tidal inlet. Some surfers prefer physical features (inlets) that cause a break in existing bathymetry to provide sufficient variation to create "peaks" and "shoulders" at sites where unrideable "walls" exist prior to the project. Concluding whether this effect is a detriment, is neutral, or is a benefit will be subjective to the individual surfer and will vary from person to person.

Currents will exist in the channel that will be outflowing (ebbing) during dropping tides and incoming (flooding) during rising tides. Ebbing tidal currents resemble a rip current that will degrade surfing conditions at the lagoon mouth during ebbing. This condition will be short-lived and mainly discernible during spring tides that occur several times every other week. Flooding tidal currents should be indiscernible to surfing quality.

7.3.4 New Nearshore Mound– Alternatives 1B and 2A

Both Alternatives 1B and 2A include installing a sand mound in the nearshore zone along the center of the reach of Cardiff Beach (approximately half-way between Cardiff Reef and Seaside Reef). The sand mound is to serve as an ebb bar for Alternative 2A off the new inlet. The sand mound is simply a beneficial sediment re-use opportunity for Alternative 1B. The nearshore mound can provide a significant surfing benefit if designed and constructed appropriately, or it can be neutral to benign on surfing. The mound should not be a detriment to surfing. Waves tend to focus on the mound and can form a peak if the mound is shallow enough, and can provide ridable shoulders if the mound outline is either in a shallow angle toward shore or curved/rounded. Waves will refract (wrap) around the mound and break over the shallow portion in a peeling left and right. Depending on the depth of the nearshore mound's crest, it can break at various tides. A very shallow mound crest can break at all tides, while a slightly deeper mound crest may only break at mid- to low tides. Even if the mound does not generate an average quality breaking wave at high tide, the wave refraction over the mound can lead to creation of a peak or multiple peaks along the beach landward of the mound.

The nearshore mound for Alternative 2A will likely be a semi-permanent feature that will be dynamic and change over time, depending on tide and wave conditions. The mound for Alternative 1B will be a temporary feature that will gradually disperse and eventually disappear. Figure 7-11 shows an example of a peak created off Huntington State Beach in 2010 by deposition of 100,000 cy of sand immediately off the beach. The mound created epic surf called the "freak peak" for about 3 months, then began to disperse and provided rideable and fair surf for another 3 months for a 6-month total lifespan.

Figure 7-11: The H.B Freak Peak Above and Below in 2010

Similarly, a larger mound was constructed off Newport Beach (Santa Ana River Mouth) in 1992 by the U.S. Army Corps of Engineers (USACE) where 1.5 million cy of sand and silt was placed nearshore. The mound formed a high-quality peak called "submarines" due to the dredge discharge line periodically surfacing and resembling a submarine. The peak was present for approximately 6 to 9 months, and held sizable surf. The mound was so large that sand dispersed off the mound toward shore and created a connecting bar from mound to beach.

Waves could be ridden over the mound and along the bar all the way to shore for a distance of approximately ¼ mile.

Sand dispersal off of the mound for Alternative 1B should not pose a detriment to surf spots at Cardiff Reef and Seaside Reef, both just up- and downcoast of the mound. Sand will disperse in a thin layer in the downcoast direction and gradually spread over a large area (footprint) over the seafloor. Due to the mound's limited sand quantity and large area of dispersal, the absolute thickness of the sand veneer at downcoast reefs is on the order of inches rather than feet, so any effects should be indiscernible to surfing.

7.3.5 Effects on Surfing at Other New Inlet Locations

Another project surfing analysis includes documentation of effects to surfing at existing and new inlets associated with restoration projects. Several recent wetland restoration projects were installed that included new tidal inlets at Batiquitos Lagoon (1996), Bolsa Chica Wetlands (2006), and Huntington Beach Wetlands (1991). Another recent wetland restoration project at San Dieguito Lagoon (2011) preserved the existing lagoon inlet condition, but increased the tidal prism and potential tidal currents. Analysis of the effects of these projects and their effects on surfing are below.

(a) Batiquitos Lagoon

Batiquitos Lagoon was restored and opened in 1996 to tidal flow through a new tidal inlet. Historically the inlet was not jettied, and was closed by a cobble berm, thereby impounding lagoon water and decreasing water quality. Restoration increased the tidal prism and stabilized the inlet with relatively short jetties to restore lagoon habitat as mitigation. The jetties are referred to non-surf zone piercing because they are intentionally too short to pierce through the surf zone. The design intent was to eliminate adverse impacts to the shoreline from sand trapping by the jetties.

While surfing off Batiquitos Lagoon was basically non-existent prior to lagoon restoration, surfing off the lagoon inlet is presently very good. The surf spot referred to as Ponto is a sand bar off the lagoon mouth at the location of the ebb bar. A sand bar was formed off the mouth by sand moving alongshore being deflected into deeper nearshore water by ebbing tidal currents, therefore termed an ebb bar. The ebb bar is crescent-shaped (concave toward shore) and thus a curved arc toward the sea. Incident waves refract (bend) over and around the ebb bar and break as a peak with sloping right and left shoulders. The bar is stable and the quality of the break is good. Conditions are reliable as the bar causes waves of nearly all sizes and directions break with similar shape. The site is affected by tides, but breaks on nearly all tides as long as sufficient wave energy exists. The surf can be crowded, but it is definitely improved over the pre-project condition. Surf contests are also held at the site. Figure 7-12 and Figure 7-13 show the Ponto site before and after restoration.

(b) Bolsa Chica Wetlands

A surfing study was conducted for Bolsa Chica in 1990 prior to restoration (M&N 1991). The study evaluated the existing surfing conditions along Bolsa Chica State Beach and identified qualities that surfers liked about Bolsa Chica. Information about surfing near structures was also provided in the study. Bolsa Chica was restored in 2006 with similar short jetties at a new tidal inlet. Since construction, this site has been heavily surfed. Surfing was always popular along Bolsa Chica due to its relative uncrowded conditions compared to more crowded sites (Huntington Cliffs and Huntington Beach Pier), and its more gentle type of wave compared to gnarlier breaks. Bolsa has always attracted a broader range of crowd, from younger kids, to women, to longboarders, to shortboarders.

Installation of new tidal inlet with jetties created another ebb bar off the mouth with a multiple peaks and shoulders. This bar is not as definitive as the one at Batiquitos Lagoon, but it exists in a different form. This inlet is wider and the lagoon has a smaller tidal prism than Batiquitos, so the ebb bar is less pronounced. However, the area off the mouth consists of variable sand bars that provide ridable surf under most conditions. The variety of the sand bars caused by the break in bathymetry at the inlet channel and ever-dynamic tidal currents provide a broad field of peaks. This site is different in character than pre-restoration Bolsa, and is generally as good of quality as before restoration and is at times of better quality. Bolsa serves as a refuge from more exposed breaks during high southern swell and can provide rideable shoulders while other breaks close out. It is also is better exposed to northern hemisphere swell than large areas of Huntington and Newport Beaches and can therefore provide higher waves in winter months under some conditions. Figure 7-14 and Figure 7-15 show the Bolsa Chica inlet location before and after restoration.

Figure 7-12: Batiquitos Lagoon Before Restoration

Figure 7-13: Batiquitos Lagoon After Restoration

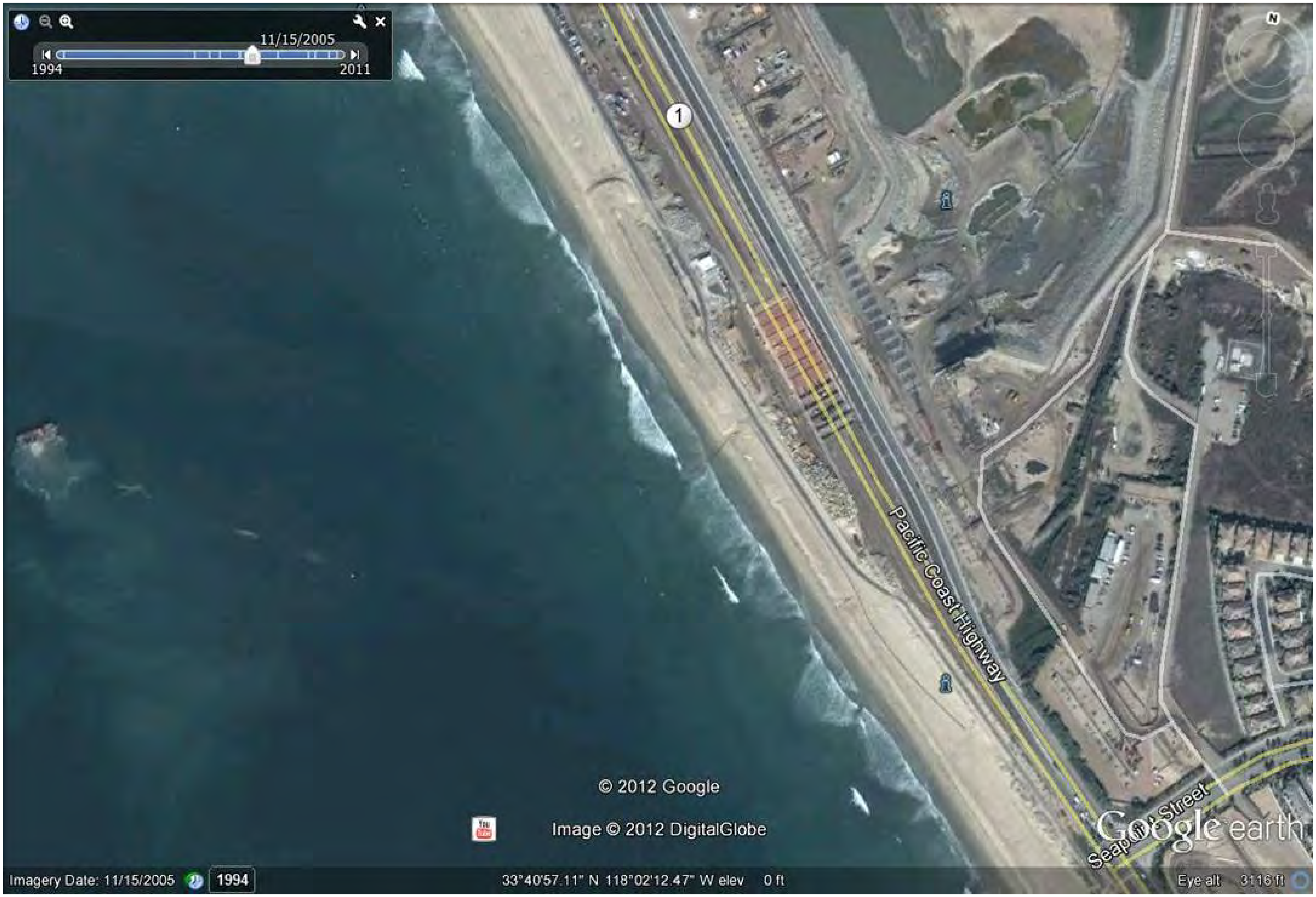


Figure 7-14: Bolsa Chica Wetlands Before Restoration

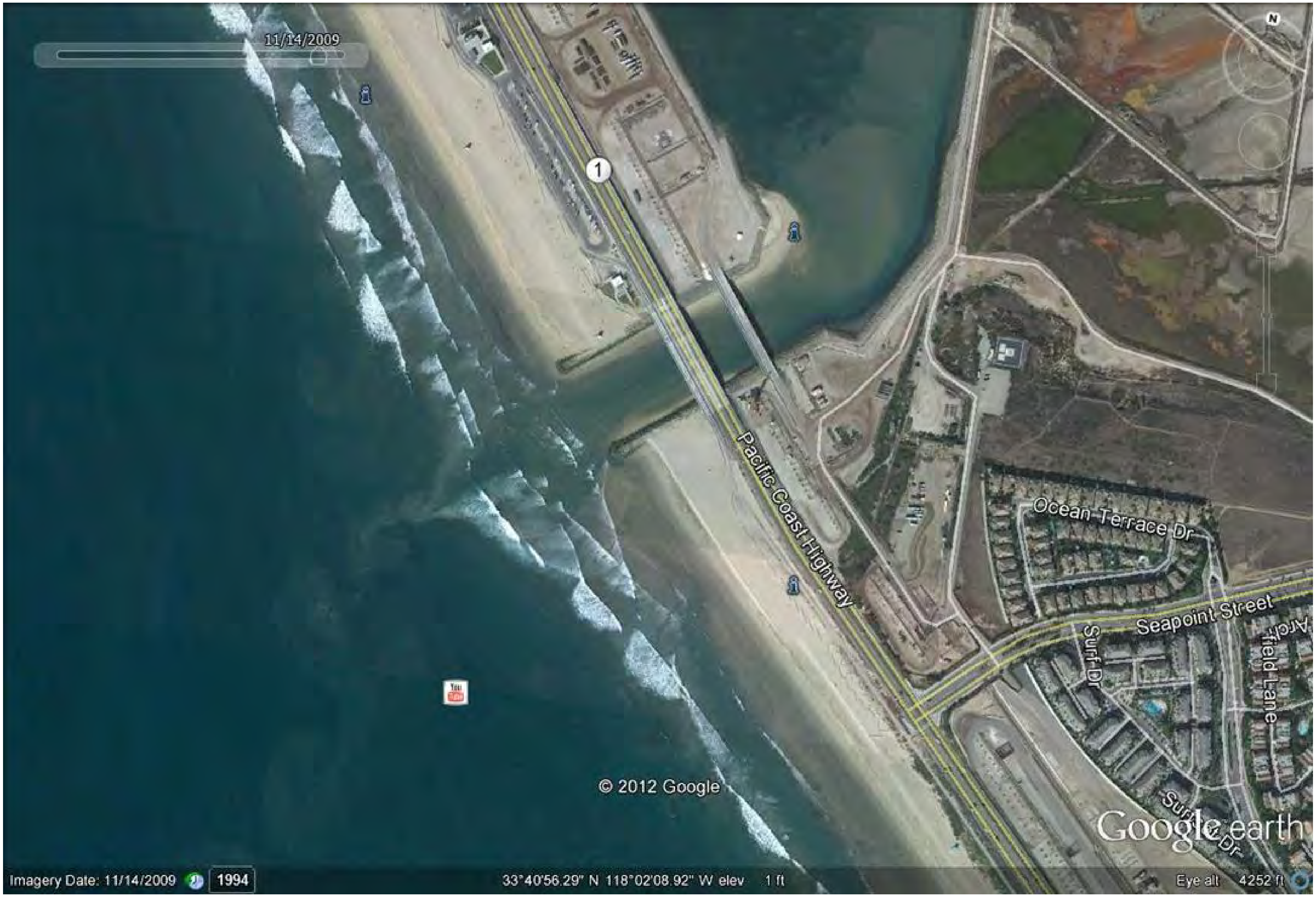


Figure 7-15: Bolsa Chica Wetlands After Restoration

(c) Huntington Beach Wetlands

The surf off the Huntington Beach Wetlands inlet is high quality. Jetties are shortest at this site compared to the previous two sites, and waves are nearly uninterrupted by the channel at most tides. The site is called River Jetties (or RJs) and consists of a field of peaks that is rideable under most conditions. RJs was a good break as far back in time as locals tend to recall, and has remained very high quality to the present. The inlet introduced a break in bathymetry that may increase the number of more defined peaks at the site than before restoration, but this is not confirmed. Dropping tides result in a strong current that tears through the line-up under certain conditions. Little or no change has occurred to the surf along RJs since installation of the tidal inlet, but the surf is good. Figure 7-16 and Figure 7-17 show examples of RJs before and after restoration.

(d) San Dieguito Lagoon

San Dieguito Lagoon is characterized by a sand bar off the mouth in the form a less defined ebb bar than the first two examples above. Surfing is relatively good off the lagoon mouth. Restoration has not apparently caused an impact to surfing at this site. Surfers frequent the mouth now, as they did prior to restoration. It is possible that restoration did not significantly change this site either, because it has possessed a lagoon mouth for decades. The increased tidal prism from restoration is relatively small compared to the first two sites described above, and the effects on sand bar formation are less dramatic. However, there is a definite attribute of sand bar formation off the mouth and surfing conditions are better at this location than along the adjacent beaches. Figure 7-18 and Figure 7-19 and show the sites before and after restoration.

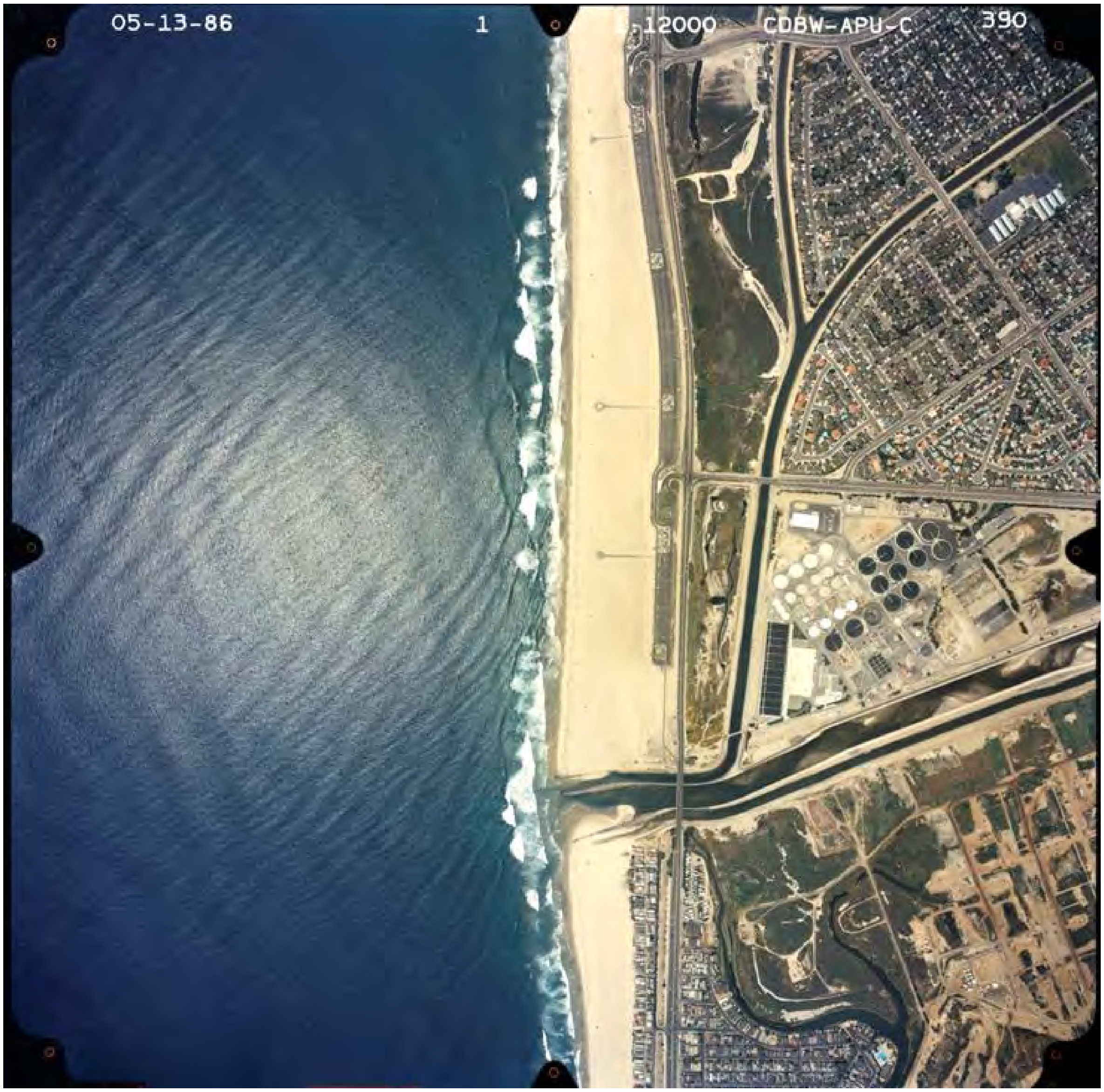


Figure 7-16: Huntington Beach Wetlands Before Restoration

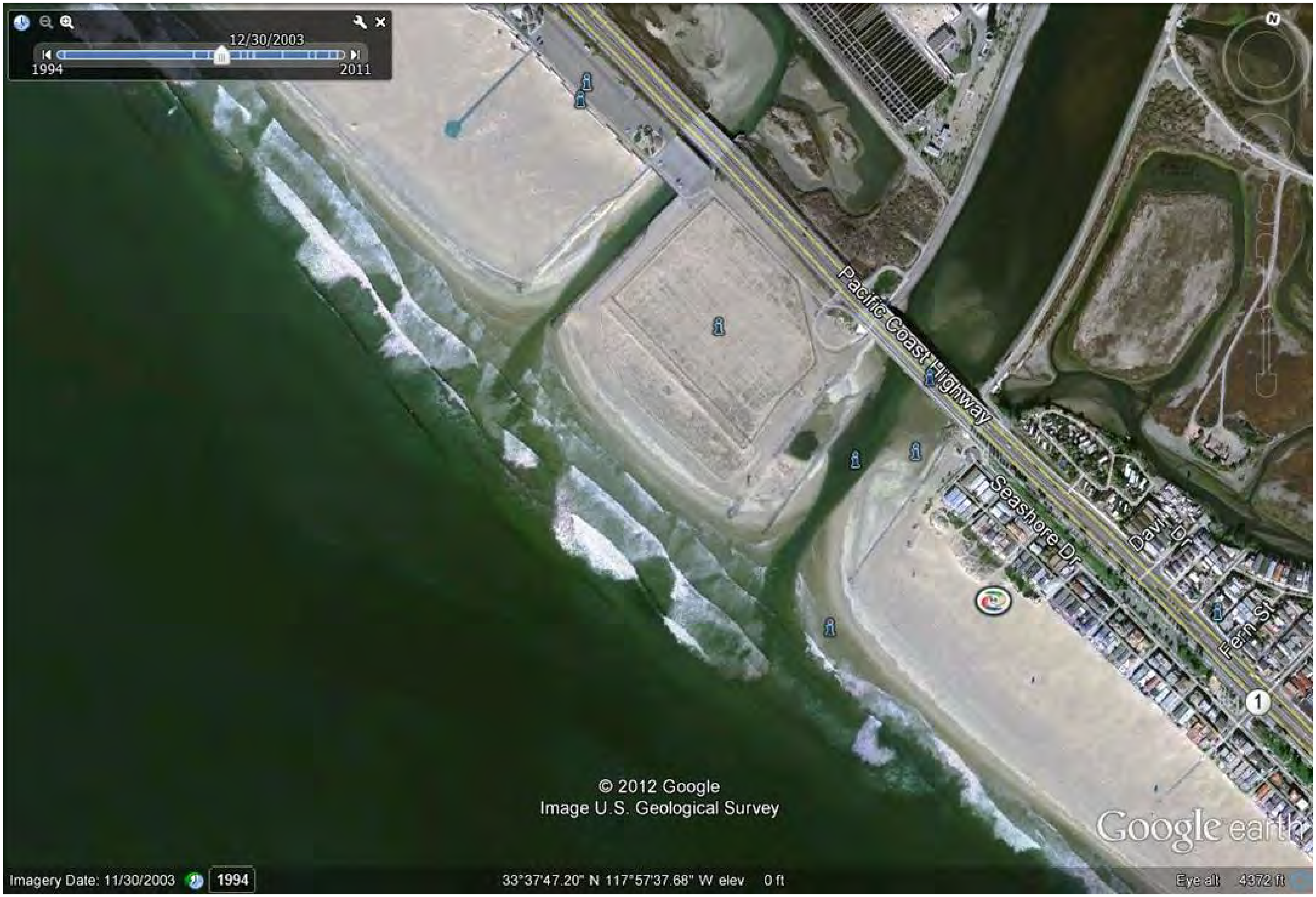


Figure 7-17: Huntington Beach Wetlands After Restoration

Figure 7-18: San Dieguito Lagoon Before Restoration

Figure 7-19: San Dieguito Lagoon After Restoration

8. CONCLUSIONS

Implementation of the SELRP will potentially have effects on surfing that may range from beneficial, to neutral, to temporarily adverse. Four alternatives are being considered that consist of No Project, and Alternatives 1A, 1B, and 2A. Two of the four alternatives (1B and 2A) involve generation of surplus sand that may be placed in the littoral zone, either on the beach and/or in the nearshore zone. Two alternatives (1A and 1B) also include changes within the lagoon that will increase the tidal prism and tidal discharges through the existing tidal inlet channel. One alternative (2A) assumes relocation of the tidal inlet channel to a new location south of the existing inlet, and closure of the existing inlet. Effects to surfing may occur from:

- Placement of surplus sand at several beaches from Moonlight Beach to Torrey Pines for Alternatives 1B and 2A;
- Increasing the volume and rate of tidal flows from the lagoon to sea through the existing inlet channel for Alternatives 1A and 1B;
- Installing a new tidal inlet south of the existing inlet, and closing the existing inlet for Alternative 2A; and
- Installing a nearshore sand bar off Cardiff Beach for Alternatives 1B and 2A.

Existing baseline surfing conditions were observed from Swami's to the San Dieguito Rivermouth for a six-month period in 2011 and 2012.

Analyses included quantitative evaluation of various possible impacts such as:

- Backwash;
- Burial of sand bars;
- Nourishment sand grain size and nearshore slope;
- Sedimentation at reefs;
- Increased or modified currents; and
- Changes in frequency of surfability.

Conclusions of the quantitative analyses indicate that with no long-term expected changes to the surf zone seabed slope, most waves that would have been surfable prior to the SELRP, would still likely be surfable under the Project condition. Exceptions are 1) during high tide during construction when a minor increase in backwash is expected and 2) at reef breaks that may temporarily experience excessive sedimentation. These changes to surfing quality can change the frequency of surfability as detailed in Table 7-8 in the report.

Excessive sedimentation can change a surf site from a reef break to more of a beach break. This type of change could reduce the surfing frequency, especially during walled conditions or windy conditions where the only surfable places tend to be reef breaks. This may be the case for reefs in Solana Beach south of tabletops, but not at other reefs. The reefs potentially impacted by sedimentation rarely break, so existing surfing frequency is low.

Given that the increased backwash is expected to be an intermittent (only during high tides) and temporary impact (during and immediately after construction) and that the reefs impacted by sedimentation rarely break, and that the new ebb bar is expected to break frequently and is a permanent feature for Alternative 2A (but temporary for Alternative 1B), the overall frequency of surfable waves within the study area are expected to improve as a result of the SELRP alternatives.

Analyses also included qualitative evaluation of the following conditions:

- Closing the inlet and creating a new inlet (Alternative 2A);
- Increasing flows at the existing lagoon mouth (Alternatives 1A and 1B);
- Installing a new and relocated inlet (Alternative 2A);
- Installing a nearshore mound (Alternatives 1B and 2A); and
- General observations of conditions at new inlets.

Results indicate the following:

Closing the inlet and creating a new inlet (Alternative 2A) – Closing the inlet should not affect surfing at Cardiff Reef or other spots. A potential concern involved loss of possible sand supply from the lagoon to the littoral zone if the inlet were closed. Sufficient evidence exists that San Elijo Lagoon inlet has closed historically and the surf quality at Cardiff Reef and nearby breaks remained unaffected. Surfing has continued over time through long periods of the existing inlet being closed so there seems to be no effect on surfing from closing the existing inlet.

Increasing flows at the existing lagoon mouth (Alternatives 1A and 1B) – Tidal flows will increase to the nearshore ocean from existing inlet alternatives. The magnitude and location of the increased tidal flows are critical to impacting surf. Numerical modeling for the lagoon shows slightly increased currents in the line-up at Cardiff Reef which could cause an impact. The model results were generated to determine flow velocities only, and the relatively low level of increase to velocities as predicted should result in no perceptible change in the ebb flow condition at Cardiff Reef. Impacts from any ebb current increase may be minimized because the ebbing nearshore current from the lagoon runs south of Cardiff Reef and follows a deeper channel around the surf break. This empirical evidence suggests that increased currents would not affect Cardiff Reef or other adjacent surf spots. Monitoring of surfing and potentially increased currents at Cardiff Reef should occur to quantify adverse impacts and identify potential mitigation measures.

Installing a new and relocated inlet (Alternative 2A) – The new tidal inlet of Alternative 2A will run through the south end of George's and change a portion of that surf spot. The change in this area may range from detrimental, to neutral, and even beneficial depending on the subjective judgment of the surfer. The remaining portions of the surf spot are anticipated to be unaffected. The new inlet will create a break in the straight nearshore bathymetry that will create a different surfable wave off the inlet mouth than presently exists. Currents will run through the inlet and affect surfing during ebbing tides and may be adverse several times per month during spring ebbing tides, but will not preclude surfing the majority of the time. Benefits have been realized for surfing at new inlets at Batiquitos Lagoon, Huntington Beach Wetlands, and Bolsa Chica Wetlands.

Installing a nearshore mound (Alternatives 1B and 2A) – A new nearshore mound installed off Cardiff Beach (i.e. seaward of Georges) will create a surf spot that does not presently exist, and may also improve surfing in the lee of the mound along Cardiff Beach compared to existing conditions. The mound can be designed to be a significant short-term benefit for Alternative 1B and a permanent benefit for Alternative 2A. Other nearshore mounds have been installed with varying success, but largely with benefits at sites such as Huntington State Beach and Newport Beach.

General observations of conditions at new inlets – New inlets tend to create new surfing opportunities that are beneficial. Several exist along the Southern California coast and are discussed for their quality. Each provides good quality surfing.

9. RECOMMENDATIONS

Several recommendations for either minimizing potential impacts and/or creating additional benefits are provided below for consideration. Recommendations are made under the categories of: 1) Beach fill design; 2) Nearshore mound design; and 3) Monitoring, and are discussed below. More recommendations may come out of the analysis by stakeholders and agencies that can be added to this study in the future.

Beach fill design - Minimizing impacts to surfing can be achieved by creating beach fills that mimic natural beach evolution. Design of the fills should be done to create a less abrupt seaward slope than many man-made beach fills to reduce impacts of backwash at high tide. Also, the planform (aerial view shape) of the fill can be adjusted to either be protective of existing surf, or to create a more discernible surfing benefit. Protection of existing surf can occur by keeping the fill narrow and not extend it into the surfzone to the location of existing sand bars. For example, designing beach fills along Cardiff Beach that are relatively narrow should be protective of the surf spot called George's for both Alternatives 1B and 2A. Alternatively, if a greater direct benefit to surfing is desired, then the fills can be shaped like sand points that protrude seaward as a triangle to form a peak.

Nearshore mound design – Surfing benefits can be increased with optimal nearshore mound design. Designs for surfing reefs have been generated by others in the past that can be applied to this project. For example, Figure 9-1 shows a reef plan view and cross-section concept developed by Kimo Walker (1974) that can be considered for application to this site.

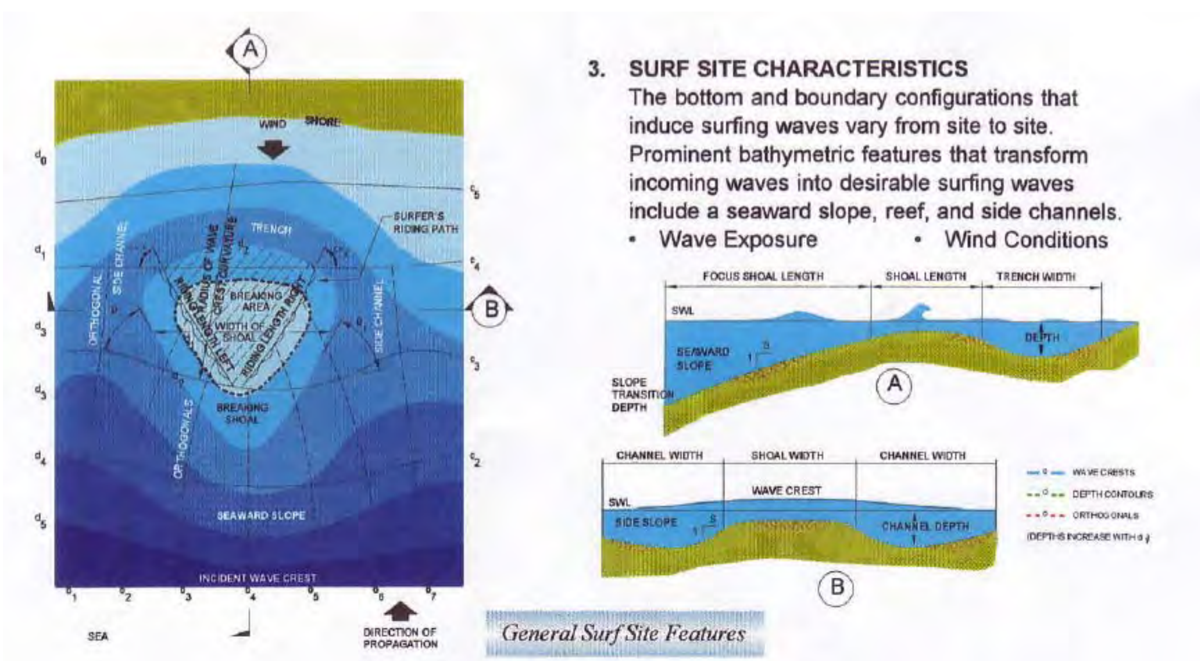


Figure 9-1: Example Surf Reef Concept Design for the Nearshore Mound

Nearshore mound design parameters include the mound's position, planform area, shape, side slopes, and elevation. Adjusting these factors will lead to varying surf conditions over the mound. The SELC can consider previous nearshore mound dimensions at other locations and lessons-learned from these experiences to design a mound that can successfully provide a surfing benefit and remain environmentally sensitive.

One variation on the mound design for Alternative 1B could be to extend its planform shoreward to connect to shore as a large triangle with the tip pointing offshore. This would create the longest ride possible at the mound, but would also bury existing sand bars along Cardiff Beach. Tradeoffs of the various mound parameters need to be considered to optimize the design.

Monitoring – Monitoring of surfing at sites affected by the project should occur to identify any impacts and potential mitigation opportunities. Beach fill placement is not anticipated to cause significant adverse impacts at fill sites outside of Cardiff Beach based on empirical evidence from other recent projects at the same sites. However, a monitoring network should be employed at Cardiff Reef, George's, and Seaside Reef at a minimum to quantify conditions over before and after construction. More sand is anticipated for placement in this area, and possible effects of increased tidal currents from Alternatives 1A and 1B, from a new inlet for Alternative 2A, and from a nearshore mound for Alternatives 1B and 2A warrant documentation and evaluation. Specifics of a monitoring plan will be developed in Phase 2 of the SELRP to be initiated in late 2013.

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APPENDIX A: SURFING MONITORING PROGRAM RESULTS

SURFING MONITORING PROGRAM OVERVIEW – PREPARED BY TIMBO STILLINGER OF THE SAN ELIJO LAGOON CONSERVANCY

This section summarizes the components of the surfing monitoring program.

Site Observations were collected twice a week at ten sites for 6 months from October 1st, 2011 till March 31st, 2012. 48 days of observations were collected. All ten sites were visited each study day between 8am and 12 noon. Stillinger collected data at every study breaks on every study day. The sites span a 4 mile stretch of coast and were visited from north to south or south to north each day (direction chosen at random to minimize effect of differences in conditions between early and late morning). More than 21 distinguishable surfing breaks are within the study zone and over 30 combined years of local surfing knowledge were used to determine the 10 breaks to be used for the surf study. These ten spots were chosen because of their frequency of use, value to the local surfing community, distance from the current and proposed lagoon inlet, and quality of ride at the break.

OUTLINE:

Parameters

Data was collected for near shore conditions that could affect the surf quality at the beaches. Local wind speed, wind direction, and tide data was collected for each of the study day.

Regional Data:

Regional data was collected for the three reaches in the study, shown by colored brackets in Figure 3. For each of these reaches total surf counts and total beach user counts were performed. Binoculars were used from a high vantage point for each reach and total surfers and beach users were counted and recorded. This data is presented in the next section and shows the variations in popularity for beach use and surfing each reach had.

Wind speed data was collected using the beaufort sea state scale.

<u>Windspeed</u>

- 0 – Mirror smooth and glassy surface
- 1 – small ripples or capillary waves on glassy surface
- 2 – Larger ripples or wavelets on glassy surface
- 3 - Wavelets of irregular direction and shape; a few crests break on glassy surface
- 4 – Small chop, defined direction; numerous whitecaps
- 5 – Heavy chop, many white foaming crests; some spray
- 6 – Larger surface waves form, whitecaps everywhere, more spray

- 7 – Sea heaps up; white foam starts to blow in streaks along direction of wind; spindrift forms
- 8 – Moderately high waves, crests begin to break into spindrift; well marked streaks of foam
- 9 – High Waves, sea begins to roll; spray begins to reduce visibility; dense streaks of foam
- 10 – sea mostly covered in white foam; visibility reduced; exceptionally large waves
- 11-17 – Research Cancelled, winds are unsafe for data collection.

For rating the surf spots, the following metrics were used in terms of wave quality and size.

<u>Surfability</u>

- Excellent: The best surf of the year at the surf break. Biggest/best swell and weather conditions line up to create very memorable surfing conditions. Rare.
- Good to Excellent: Mostly good waves, few excellent waves. Only occur during the better swells of the year.
- Good: Quality waves, typical conditions when a swell is hitting the coast.
- Fair to Good: Generally fair surf with some good waves. Typical conditions when a swell is hitting the coast but some factor (weather, tides, or surf break bathymetry) is limiting surf quality
- Fair: Very average surf with many fair waves.
- Poor to Fair: below average surf, some fair waves.
- Poor: Well below average surf, no good or fair waves.
- Ex Poor: Waves not enjoyable for any type of surfboard. Most of the time is spent waiting for or trying to catch very mediocre waves. Not flat but really bad
- Not Breaking: no surfable waves for any type of surfboard.

- WAVE HIGHT SCALE
  - **1'** = shin high
  - **2'** = knee high
  - **3'** = waist high
  - **4'** = shoulder high
  - **5'** = head high
  - **6'** = 1 foot overhead
  - **8'** = 3'overhead
  - **10'** = 5' overhead or Double Overhead faces
  - **12'** = Double Overhead+ faces
  - **15'** = Triple Overhead faces

Surf Quality Methods: Nine parameters with specific values to choose from were collected daily to describe the shape and break of the waves at each location. The parameters and values for each follow. Definitions are in appendix A.

- **Shape:** Mushy, Steep, or Hollow.
- **Speed:** Slow or Fast
- **Face:** No Shoulder, Small Shoulder, Peeling, Sectioning, Walled with Corners, or Closed out.
- **Peak:** Tight Peak, Spread Peak, Peaky, Shifty Peaks
- **Power:** Weak, Punchy, or Powerful
- **Consistency:** Consistent, Inconsistent, or Very Inconsistent
- **% Unsurfable:** 0%, 1-20%, 21-79%, 80-99%, or 100%
- **Ride Length:** 0ft, 1-99ft, 100-300ft, 301-900ft, or more than 900ft
- **Ride Time:** 0 seconds, 1-5 seconds, 6-10 seconds, 11-15 seconds, 16-20 seconds, 21-25 seconds, 26-30 seconds, more than 30 seconds

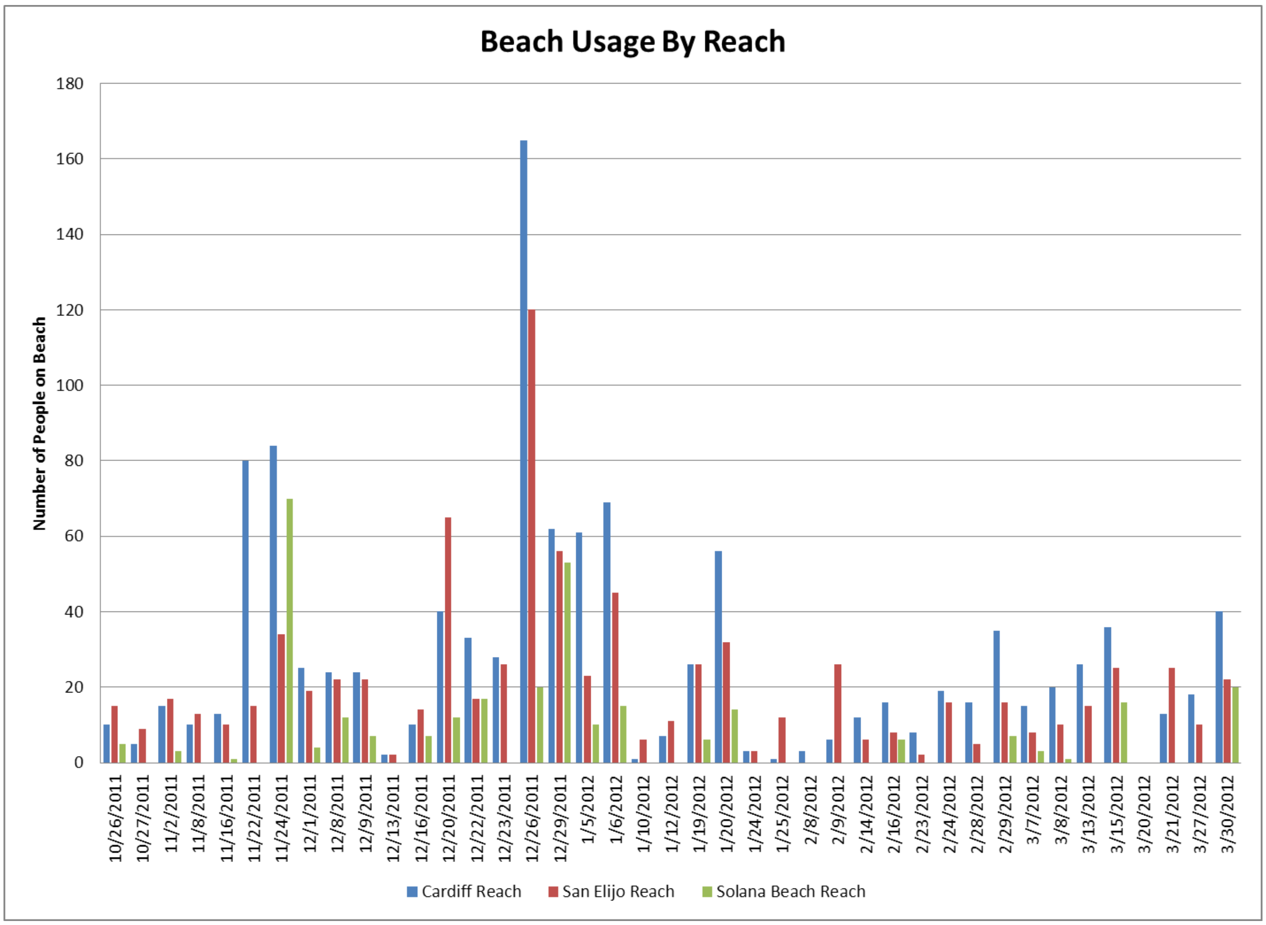
The number of observations of each value over the course of the study period was totaled and these results are described in tables for each surf break.

Surfing Monitoring Program Results – Existing condition

GENERAL USE BY REACH

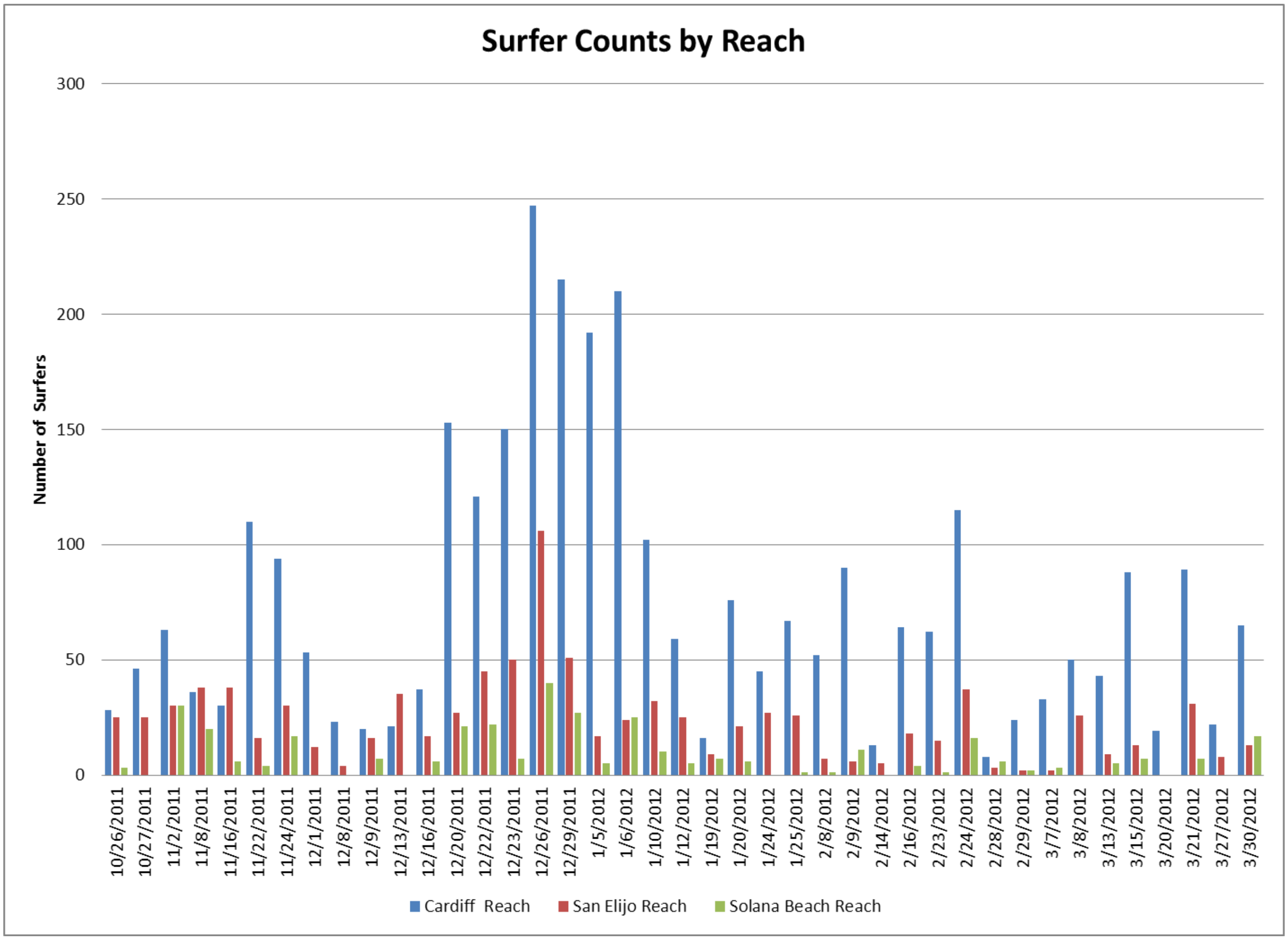
General use data (both people on-beach and surfing) were collected along three segments of coast within the study area. Data from these reaches are presented in this section.

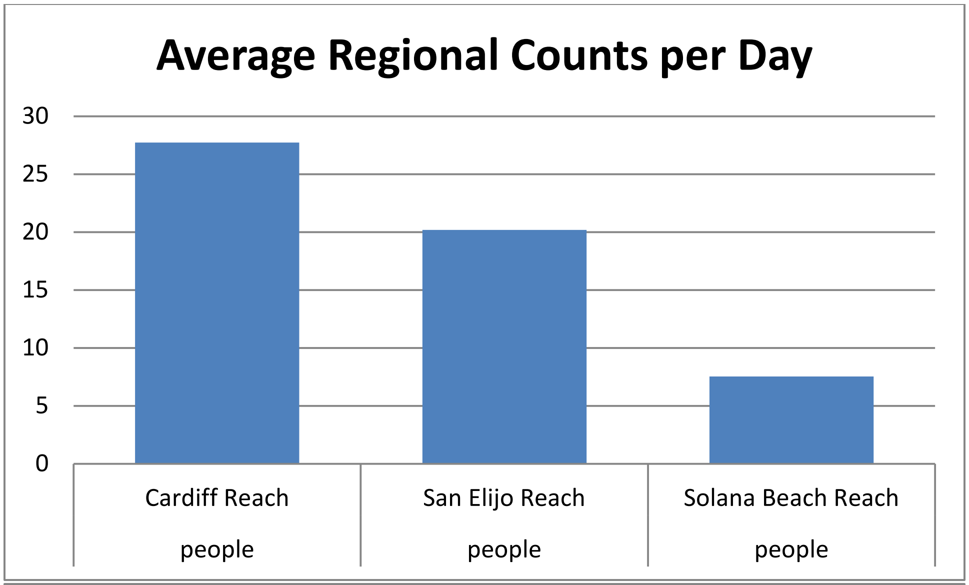
Below is the usage data collected comparing the numbers of people who used each stretch of coast. Spikes can be seen at all location around the holidays (thanksgiving, last week of the year) The Cardiff Reach consistently had the most beach goers. Many factors are at play here. This reach is directly below the San ELijo State Beach Campgrounds and sees added traffic from the camgrounds. The Solana reach showed the least foot traffic partially because of decreased access at high tides. Many days during the study the water level was too high in Solana Beach to access the beach, with breakers crashing aginst the cliff. On these same days there was still dry beach for people to walk on along the San Elijo and Cardiff Reaches.

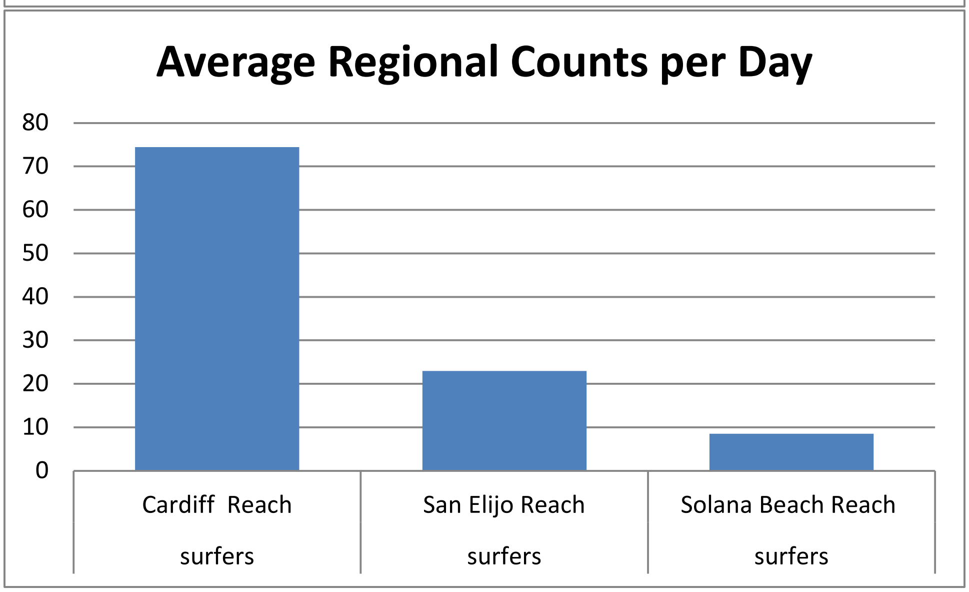


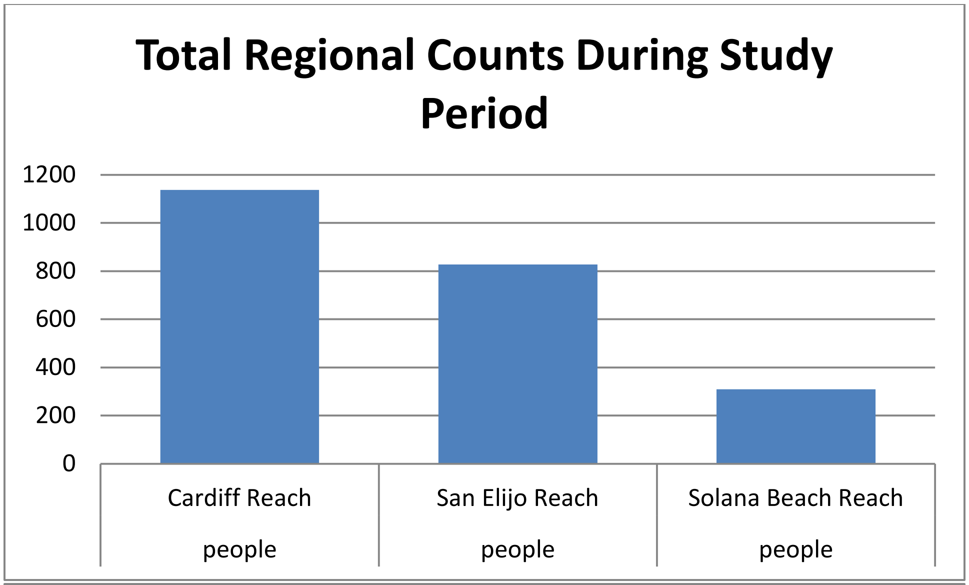
SURFER USE BY REACH

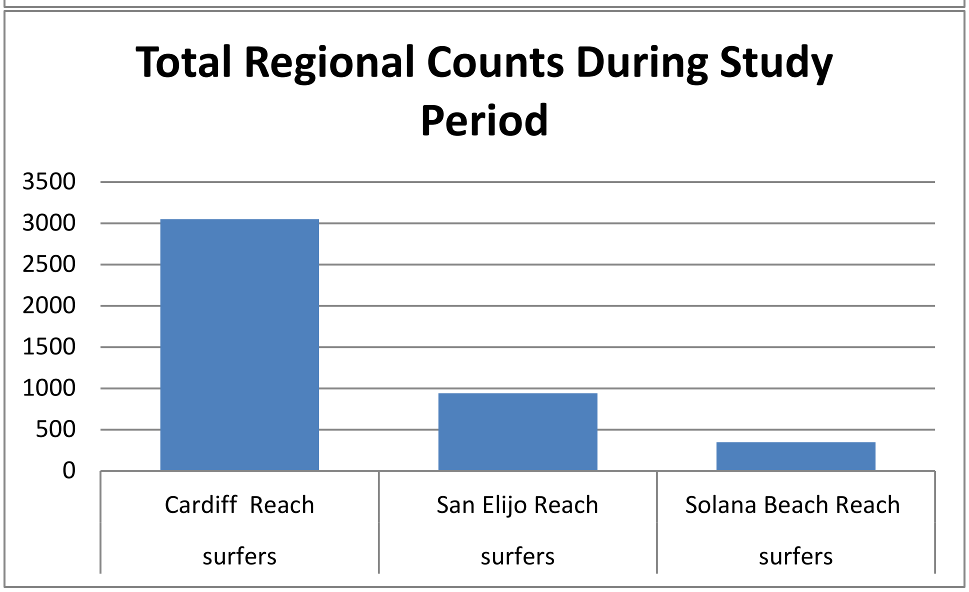
Below are the surfer counts by reach for the study period. The Cardiff Reach consistently had the most surfers. While the reaches are all similar lengths of beach, there are the most surf spots along the Cardiff stretch. The Cardiff stretch sees use from the Campgrounds as well and benefits from multiple public parking lots, easy beach access, and many friendly waves. The Cardiff Stretch is the longest, so this could be one reason for increased surf usage, along with the higher density of surf spots and the higher quality of waves in Cardiff.




Average Regional Counts per Day
30
25
20
15
10
5
0
Cardiff Reach people
San Elijo Reach people
Solana Beach Reach people


Average Regional Counts per Day
80
70
60
50
40
30
20
10
0
Cardiff Reach surfers
San Elijo Reach surfers
Solana Beach Reach surfers


Total Regional Counts During Study Period
1200
1000
800
600
400
200
0
Cardiff Reach people
San Elijo Reach people
Solana Beach Reach people

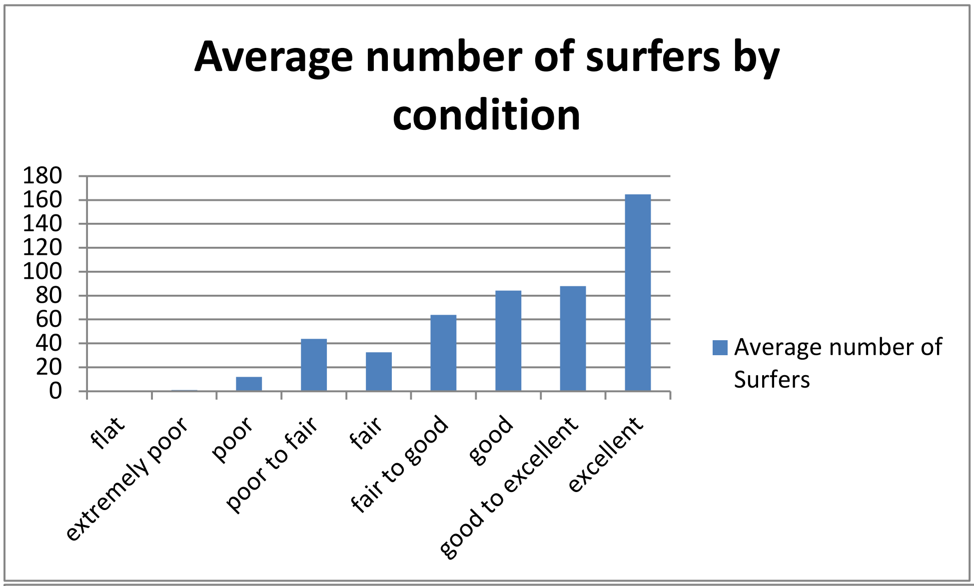

Total Regional Counts During Study Period
3500
3000
2500
2000
1500
1000
500
0
Cardiff Reach surfers
San Elijo Reach surfers
Solana Beach Reach surfers

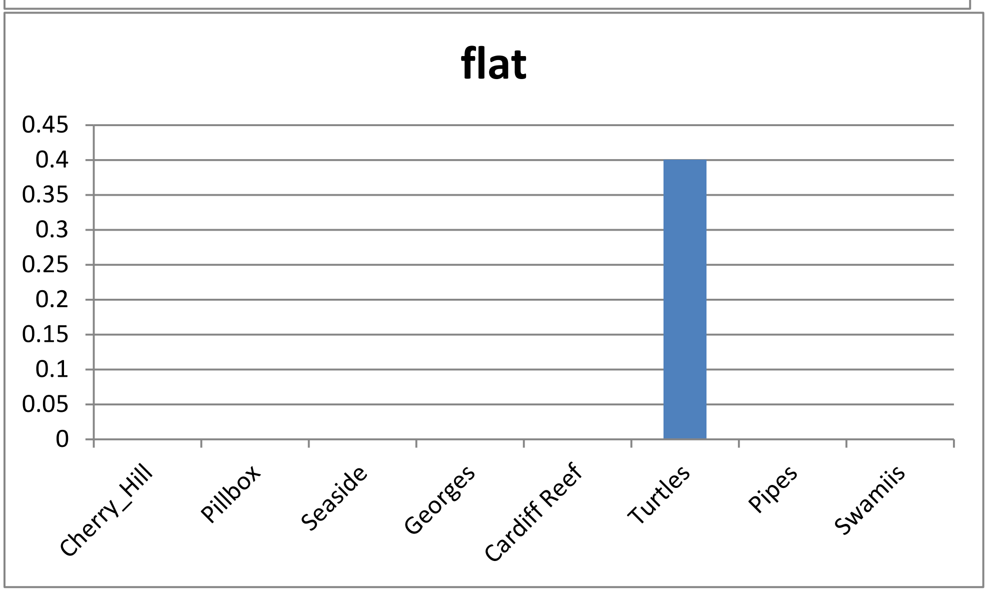
SURFING

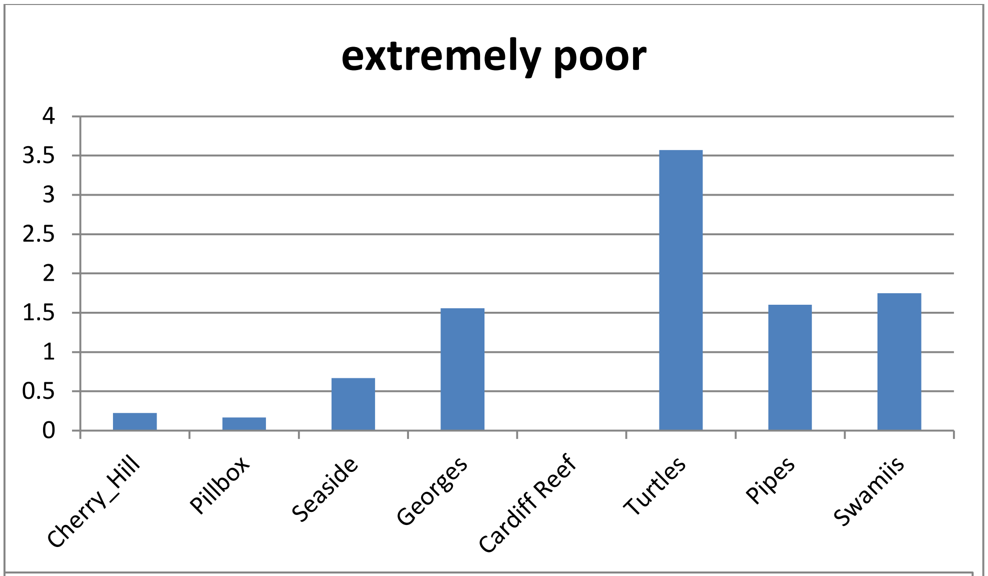
This section summarizes the results of the surfing monitoring program. The program entailed the site observations at 10 sites, twice weekly during the study period of October 2011 to May 2012. The study sites were located within the Cities of Encinitas and Solana Beach, as shown in Figure 3.

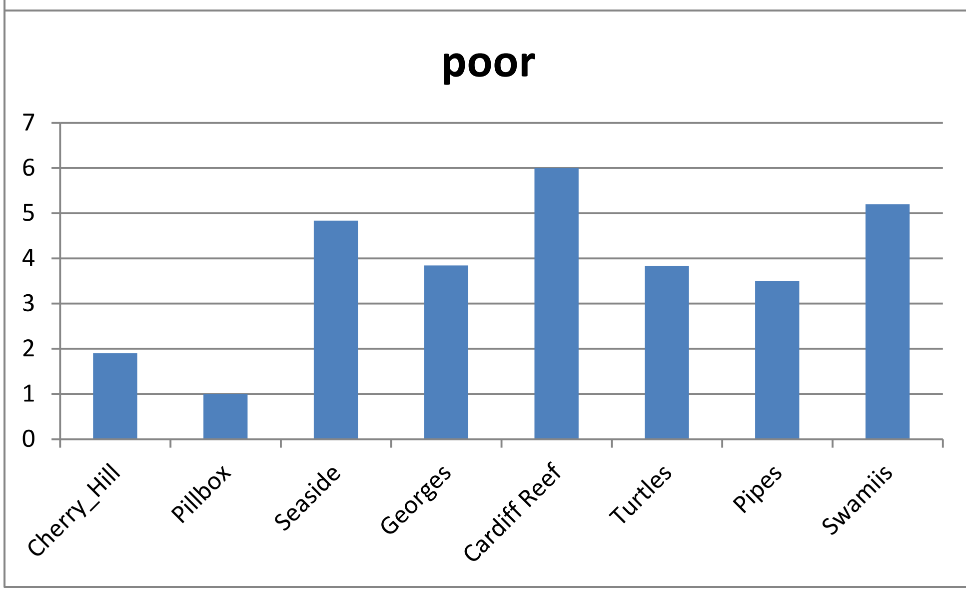
STUDY AREA CHARACTERISTICS

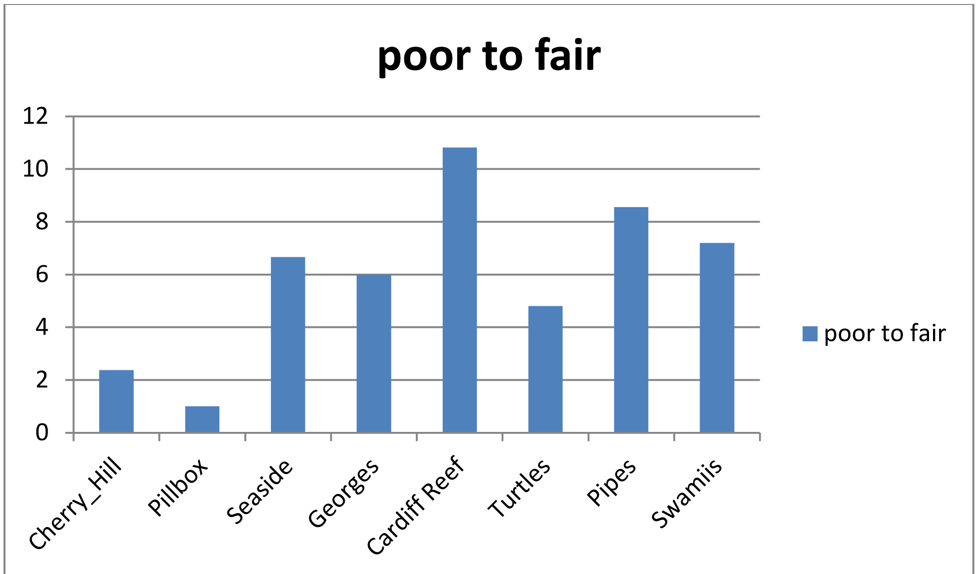
Data of surf spot characteristics and counts of surfers at each site for various conditions is provided herein..

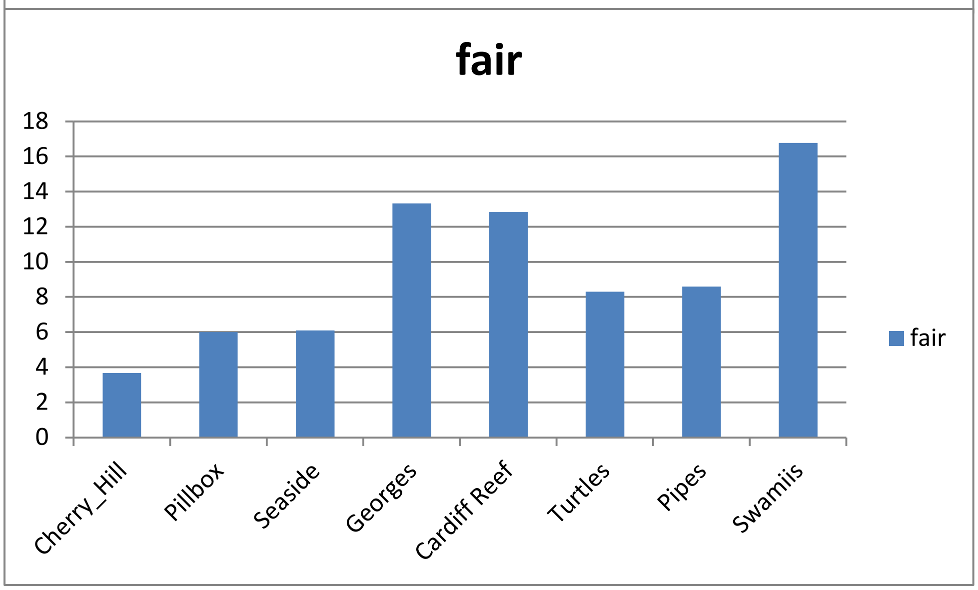





extremely poor
4
3.5
3
2.5
2
1.5
1
0.5
0
Cherry_Hill
Pillbox
Seaside
Georges
Cardiff Reef
Turtles
Pipes
Swamiis


poor
7
6
5
4
3
2
1
0
Cherry_Hill
Pillbox
Seaside
Georges
Cardiff Reef
Turtles
Pipes
Swamiis


poor to fair
12
10
8
6
4
2
0
Cherry_Hill
Pillbox
Seaside
Georges
Cardiff Reef
Turtles
Pipes
Swamiis
poor to fair


fair
18
16
14
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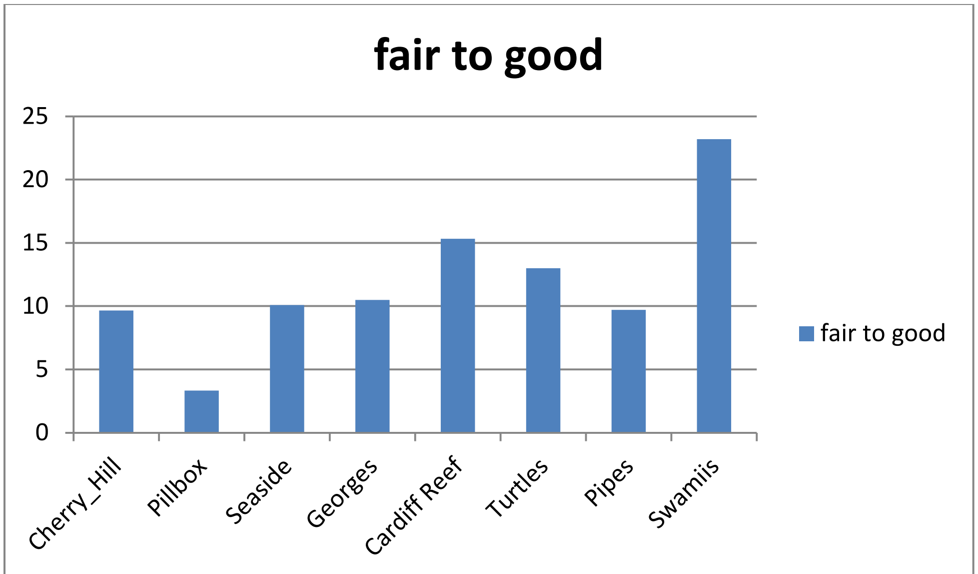
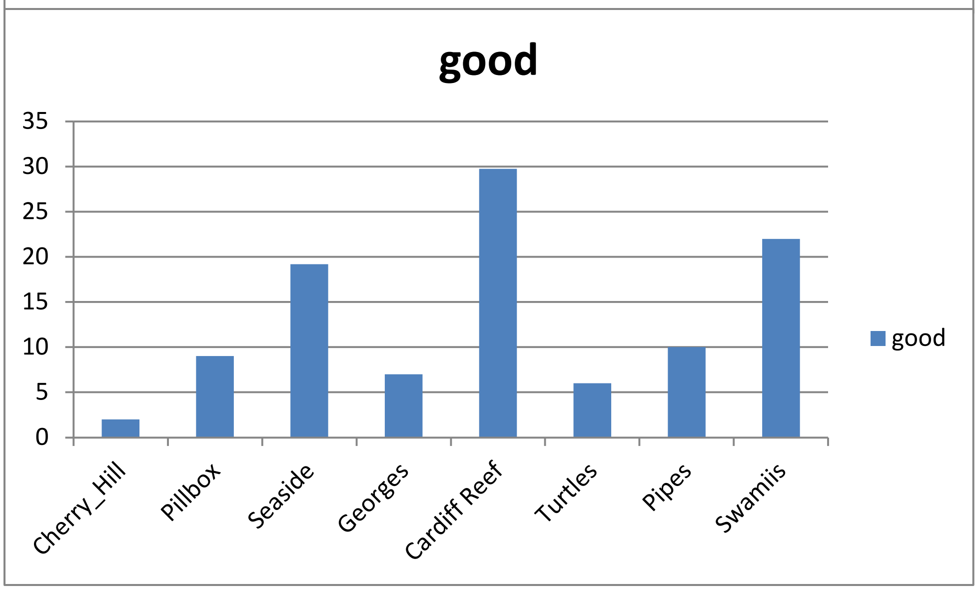
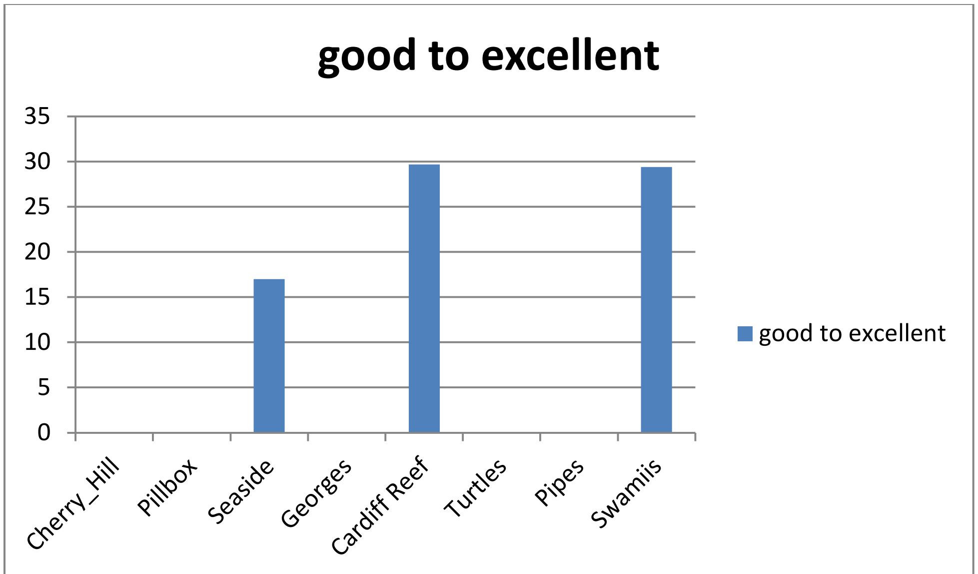
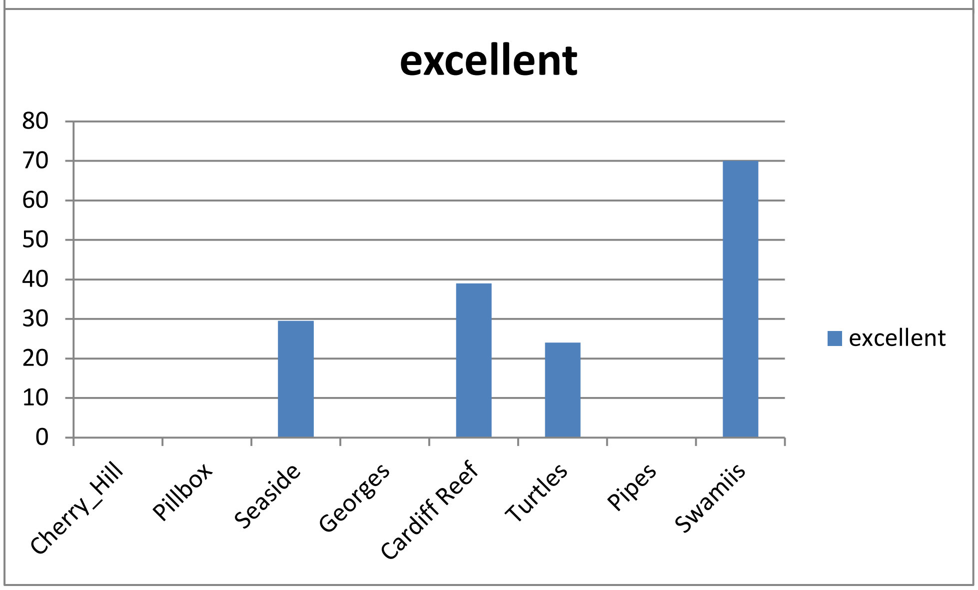
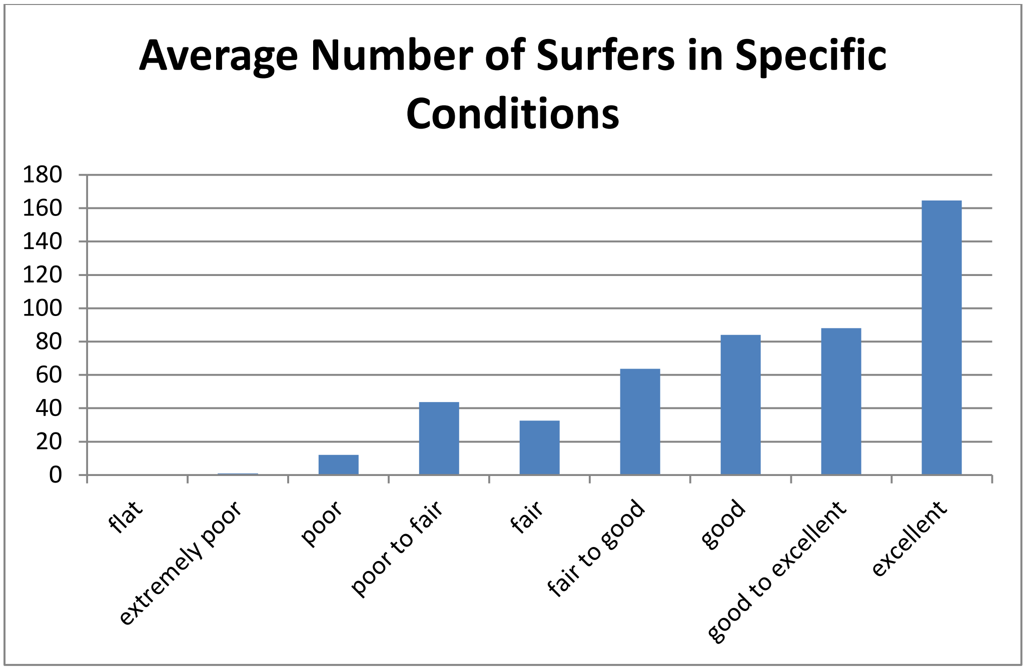
2
0
Cherry_Hill
Pillbox
Seaside
Georges
Cardiff Reef
Turtles
Pipes
Swamiis
fair


fair to good
25
20
15
10
5
0
Cherry_Hill
Pillbox
Seaside
Georges
Cardiff Reef
Turtles
Pipes
Swamiis
fair to good


good
35
30
25
20
15
10
5
0
Cherry_Hill
Pillbox
Seaside
Georges
Cardiff Reef
Turtles
Pipes
Swamiis
good


good to excellent
35
30
25
20
15
10
5
0
Cherry_Hill
Pillbox
Seaside
Georges
Cardiff Reef
Turtles
Pipes
Swamiis
good to excellent


excellent
80
70
60
50
40
30
20
10
0
Cherry_Hill
Pillbox
Seaside
Georges
Cardiff Reef
Turtles
Pipes
Swamiis
excellent


Average Number of Surfers in Specific Conditions
180
160
140
120
100
80
60
40
20
0
flat
extremely poor
poor
poor to fair
fair
fair to good
good
good to excellent
excellent

CARDIFF REACH – INFORMATION PAGE FOR EACH BREAK WITH MAP, TEXT, GRAPHS, AND SURVEY RESULTS

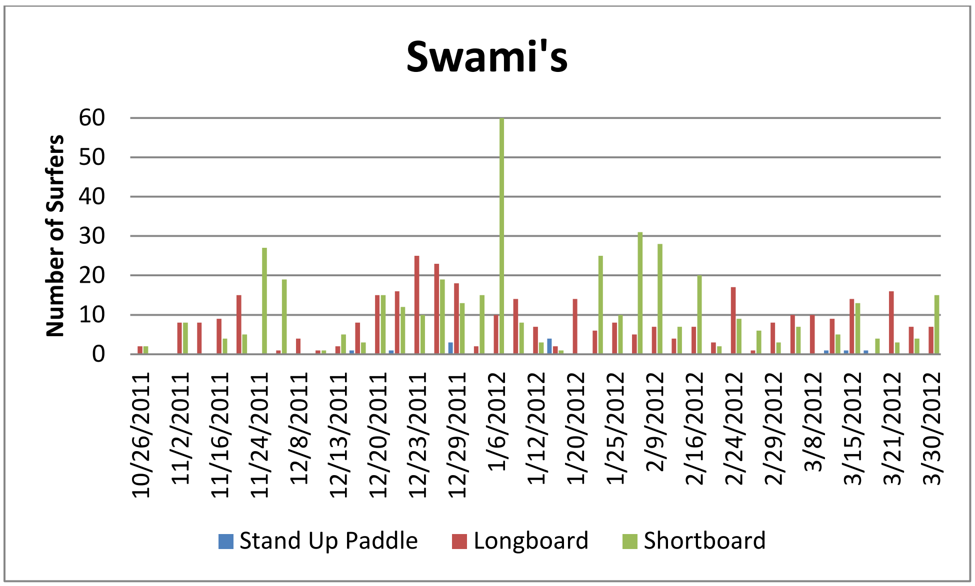
SWAMI'S

Swami's		
	Lefts	Right
Takeoff locations	1	2
Wave Breaking Speed	Fast	Fast
Breaker Type	Mushy to Steep	Mushy (<4 ft); hollow (>6 ft)
Approx. Max. Ride Length (ft)	500 ft	1,000 ft
Best Tide	Low to mid	Low to mid
Approx. Max. Ride Time (sec)	10 to 15 sec	30 sec

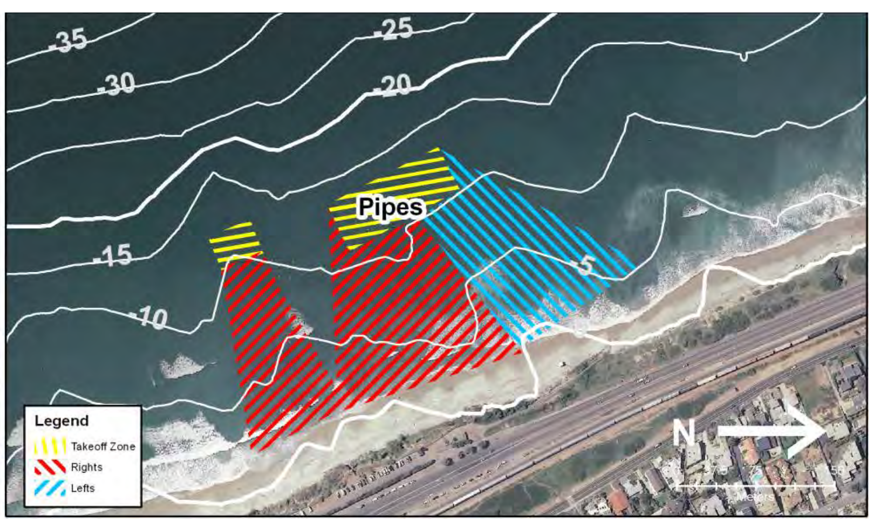
Swami's is an excellent right-hand, reef point break. It is one of the most popular and heavily surfed breaks in the region due to the length of ride and ability to hold the largest swells. Swami's is ridden at any size but is considered better with larger swells when rights connect through the entire length of the point. While the right is more famous, the left at Swami's is also a quality wave and is a steep peeling wave that does not closeout. The left is shorter than the right and not as consistent but is still better than many of the other waves within the reach.

At higher tides Swami's becomes mushy and inconsistent and during higher tides on small days is only surfable on longboards. The bigger the waves get the less the tides affect them. The large deep channel to the south allows an easy paddle out during even during the largest swells. During larger swells there are hollow sections on the inside. Swami's is surfed by long boarders under all conditions. When small, the wave is best suited to longboards and fishes. Once the wave reaches 3-6 feet it becomes an excellent wave for short boarding as well.

On large days the peak splits into an inside bowl section and an outside section. On these large days most set waves have a spread hollow breaking pattern that pinches and fades before the inside section. These are excellent short waves, the better sets though, connect through to the inside section in peel all the way to the shore. The inside section focuses both the reformed waves from the outside set waves that fade off and sets that swing wide and did not break on the outside section. The inside section has a steep abrupt takeoff followed by a long walled and hollow wave that races to the beach.

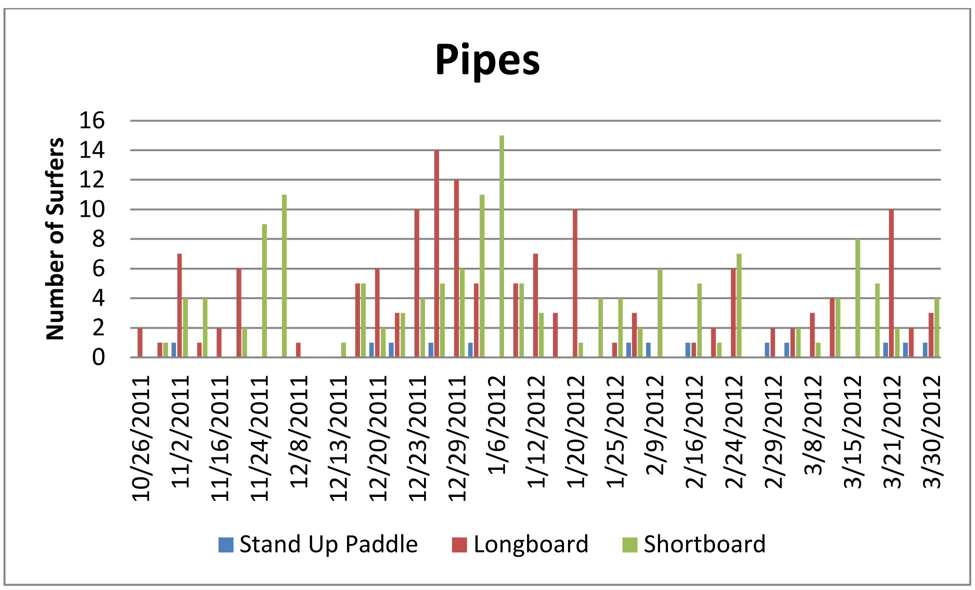


PIPES

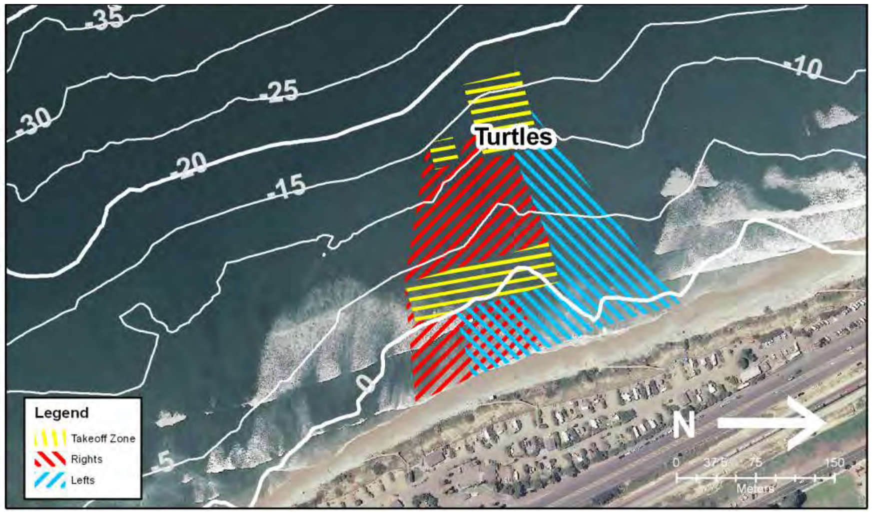


PIpes		
	Lefts	Rights
Takeoff locations	1	1
Wave Breaking Speed	Slow	slow
Breaker Type	Mushy to Steep; Peeling to Sectioning	Mushy to Steep; Peeling to Sectioning
Approx. Max. Ride Length (ft)	500 ft	500 ft
Best Tide	Low to mid	Low to mid
Approx. Max. Ride Time (sec)	10 to 15 sec	10 to 15 sec

Pipes is a peeling left and right reef break. The break has a consistent singular peak composed of reef and scattered sand throughout. Works on both NW and SW swells. The wave quality is good and is consistently surfed. Pipes is suited to fuller volume shortboards and longboards on all but the larger swell days.



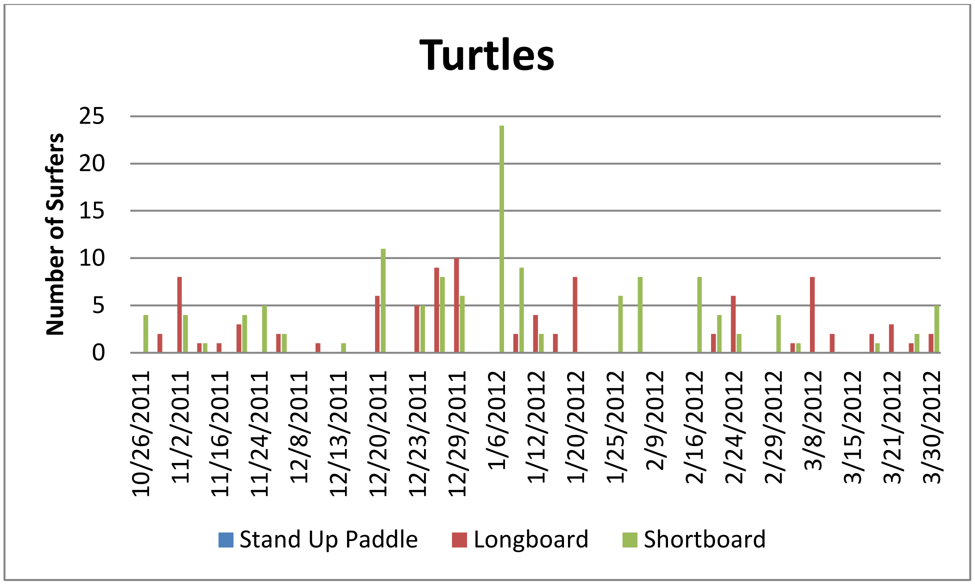
TURTLES



Turtles		
	Left	Right
Takeoff locations	1, tight	1, tight
Wave Breaking Speed	Slow	Slow
Breaker Type	Mushy/Steep/Hollow Small shoulder/ peeling	Mushy/Steep/Hollow Small shoulder/ peeling
Approx. Max. Ride Length (ft)	500 ft	500 ft
Best Tide	Low to mid	Low to mid
Approx. Max. Ride Time (sec)	10 to 15 sec	10 to 15 sec

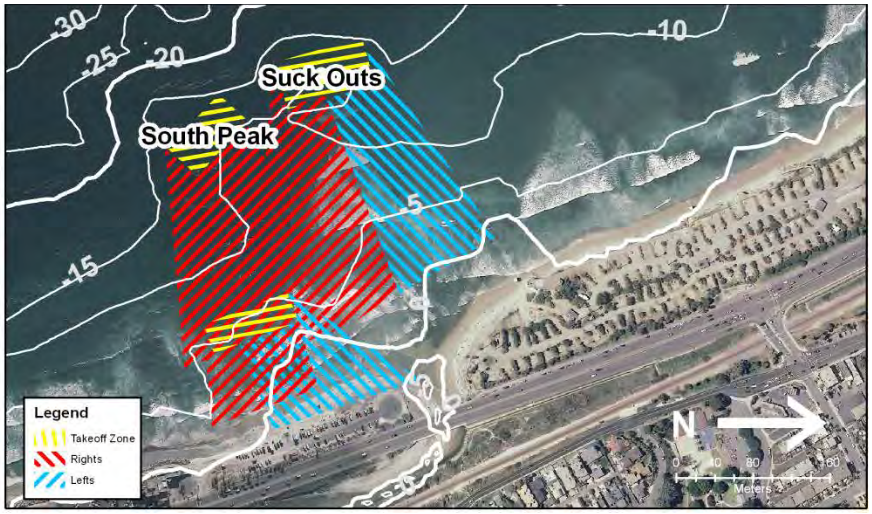
Turtles is a defined and fairly long left and right-hand reef break. This reef can hold significant sized swells; however, not as big as Swami's and Cardiff Reef. On large swells, the biggest sets will closeout across the reef and in between waves will offer large hollow barrels on the right. The left is a easier, but still fast long left wave that is ridden by short boarders and longboards. Rarely are waves ridden all the way from the outside to the beach, the ocean bottom deeps indie of the reef and after a shot intense breaking period the right fades out or closes out.

At high tides when little swell is in the water the outside does not break and short waves break on the inside offering beginner type waves of poor to fair quality breaking onto the beach. Turtles is suited to experienced and confident surfers only on large swells. Turtles appeals to high performance short boarders during ideal conditions and long boarders and beginners on small days. Spot is heavily surfed due to its consistency and ability to handle a variety of conditions and tides. Spot is more shadowed to SW swells than some of the other breaks in this region.



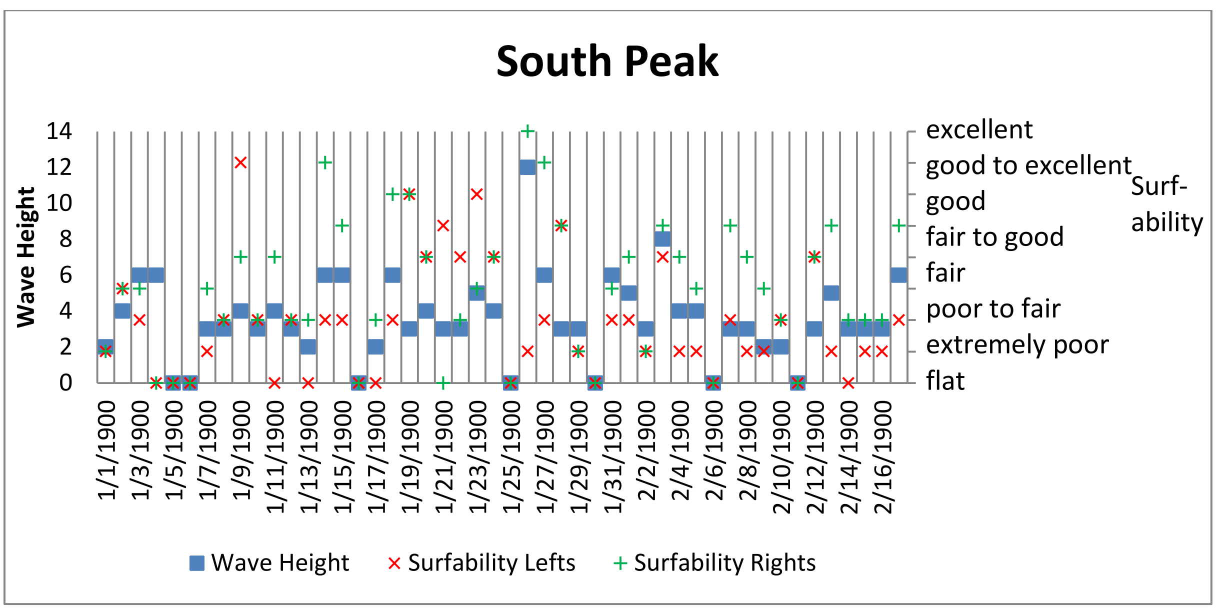
Turtles
Number of Surfers
25
20
15
10
5
0
10/26/2011
11/2/2011
11/16/2011
11/24/2011
12/8/2011
12/13/2011
12/20/2011
12/23/2011
12/29/2011
1/6/2012
1/12/2012
1/20/2012
1/25/2012
2/9/2012
2/16/2012
2/24/2012
2/29/2012
3/8/2012
3/15/2012
3/21/2012
3/30/2012
Stand Up Paddle
Longboard
Shortboard

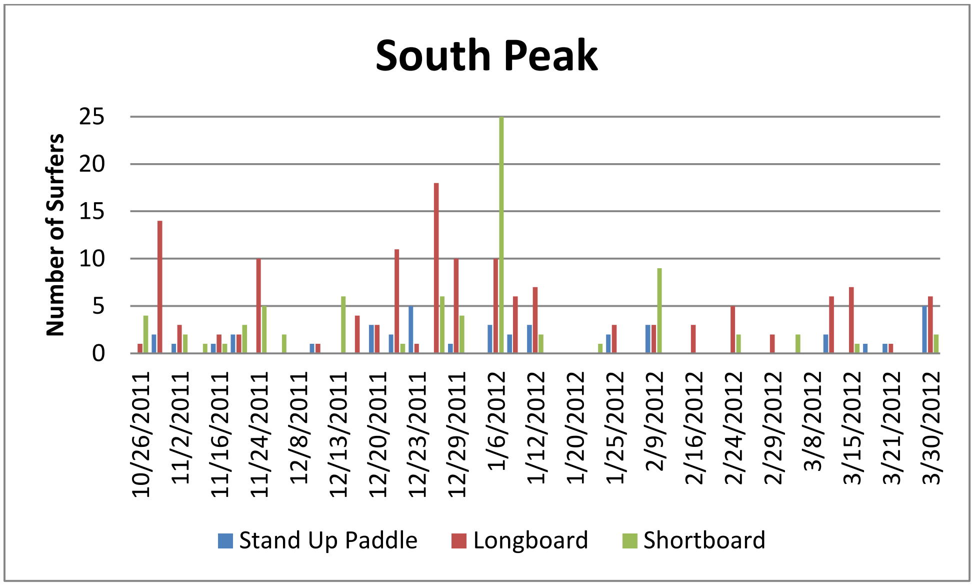
CARDIFF REEF (South Peak and Suck Outs)



South Peak		
	Left	Right
Takeoff locations	1	2
Wave Breaking Speed	Slow	Slow
Breaker Type	Closed out/peeling	Peeling
Approx. Max. Ride Length (ft)	300 ft	1000 ft
Best Tide	Very high	any
Approx. Max. Ride Time (sec)	10 to 15 seconds	20 seconds

South Peak:

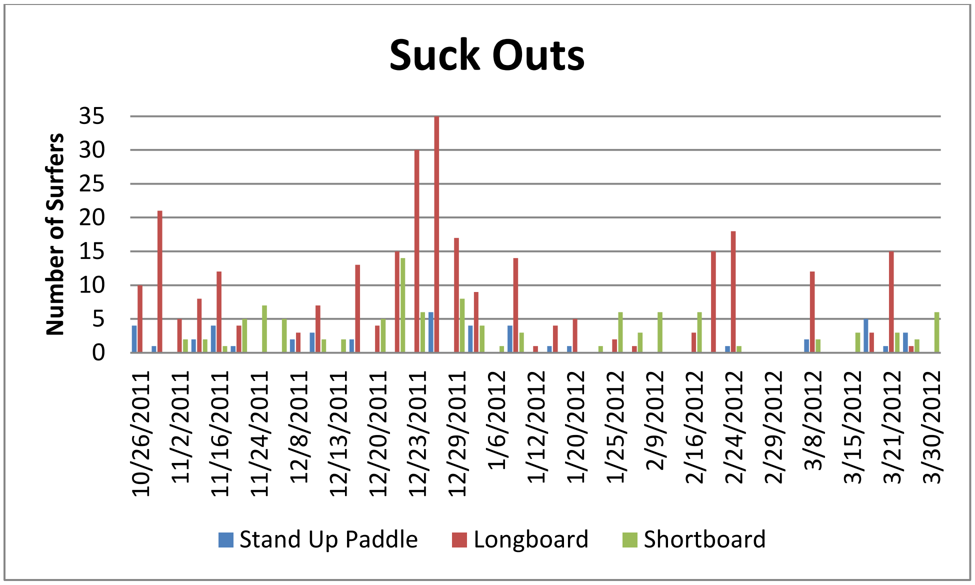




Suckouts:

Suck Outs		
	Left	Right
Takeoff locations	1	1
Wave Breaking Speed		
Breaker Type	Punchy/powerful Steep/hollow	Punchy/powerful Steep/hollow
Approx. Max. Ride Length (ft)	1000 ft	1000 ft
Best Tide	Low to mid	Low to mid
Approx. Max. Ride Time (sec)	40 sec	40 sec

A fast, hollow, left and right-hand reef break located immediately seaward of the river mouth. The wave is known as the hollowest in the reach. The wave is highly surfed by short boarders because of its power compared to some of the other breaks in the region. Works during both NW and SW directions and typically maxes out around eight-foot. During smaller days and at very high tides the wave is heavily surfed by a mix of short boarders, stand up paddle boarders, and long boarders.



Cardiff Reef is a long left and right-hand reef/point break. Due to its size, the area is divided into two sub-breaks (namely South Peak and Suckouts). The position of South Peak varies depending on swell direction, tide, and sand bar morphology, however is generally located south of the river mouth. The wave is a right-hand, reef point-break with some scattered sand (mostly on the inside). The wave offers a long and typically slow ride, which makes it very popular with longboarders, fun-shapes, and stand-up paddle boards during average wave conditions. During above average conditions and especially during larger swells from the SW and NW, the wave becomes faster and hollower and allows for waves with multiple maneuvers for shortboards. The spot can hold the largest waves of the season and also provides a channel (although not as defined as Swami's) on the south side of the break. At very high tides, the waves that break on the inside are ideal for longboarding and can offer the only surf-able waves in the region during the highest tides of each month.

Waves within reach data was not collected for:

Dabbers: Left and right-hand, reef and sand bottom wave. Spot works during big north/northwest swells. Therefore, the wave is infrequently surfed and overall wave quality is low at this time. On the biggest swells of this winter, this wave closed out across to Swami's on the largest sets and offered up uncrowded lefts and rights in between.

Brown House: Left and right-hand peak. Mostly sand with some scattered reef. The spot is frequently surfed and is a moderate to low wave quality until large swell events create beach break type walled fun short boarding waves. Generally frequented by less experienced surfers. Under epic conditions, this wave is suited to high performance short boarding with steep, fast, punchy waves.

Traps: A-frame wave of moderate to good quality. Primarily reef with some sand scattered throughout. Short right and longer left that allows a few maneuvers in either direction. After breaking on the outside, the right slows down when it hits a deep spot and then reforms and typically closes out on the inside. Consistently surfed due to wave form and channels. Spot is more shadowed to SW swells than some of the other breaks in this region.

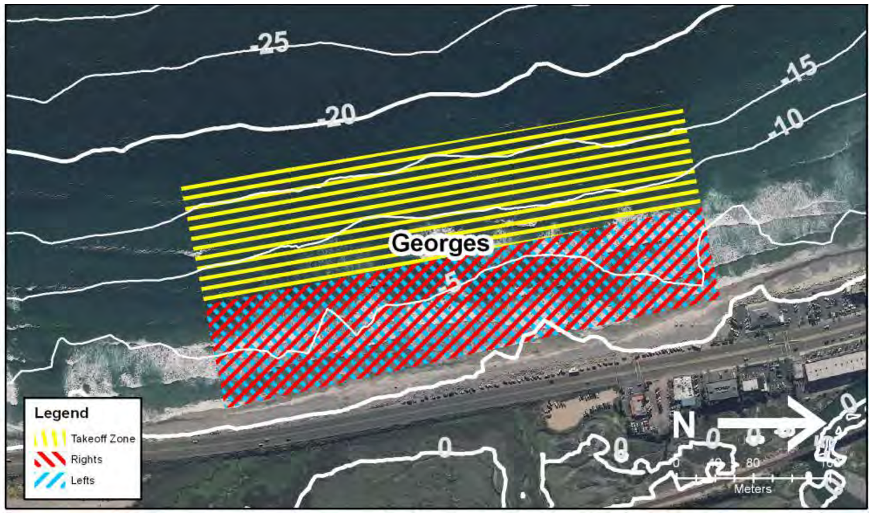
Barneys: Scattered peaks along a stretch of reef whose form can vary significantly based on wave direction(s) and tide. Best during NW swells and is typically surfed by less experienced surfers. Spot is more shadowed to SW swells than some of the other breaks in this region.

85's: Right hand reef break. Works primarily in the winter with NW swells under approximately eight feet. Wave can be fast and very maneuverable, therefore, is typically ridden by shortboarders. Spot is more shadowed to SW swells than some of the other breaks in this region.

Tippers: Left and right hand reef break. Is best during winter NW swells, however, is exposed to and breaks during both NW and SW swells. The left is generally longer with better form than the right. The left can offer a hollow section during swell and low tides. Highly surfed and good wave quality

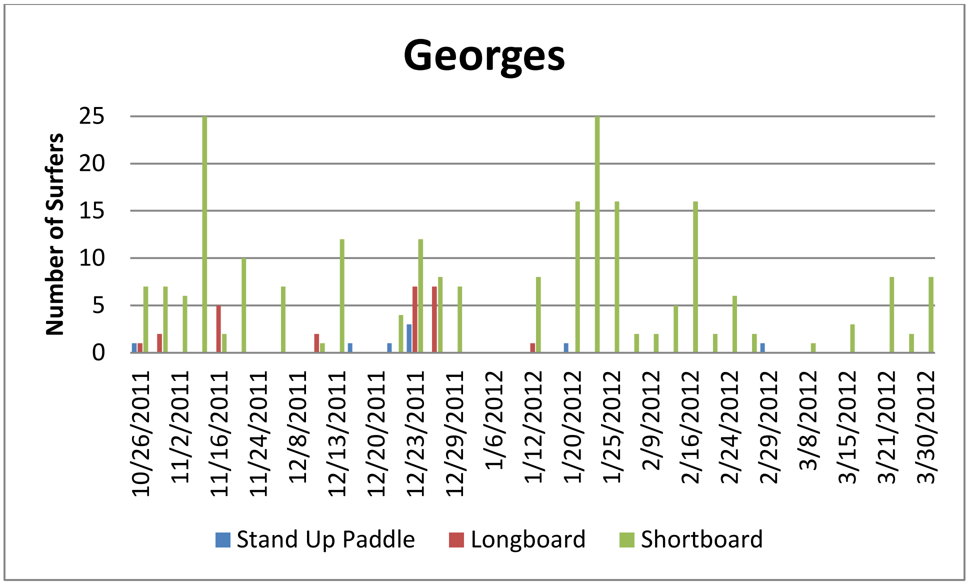
SAN ELIJO REACH

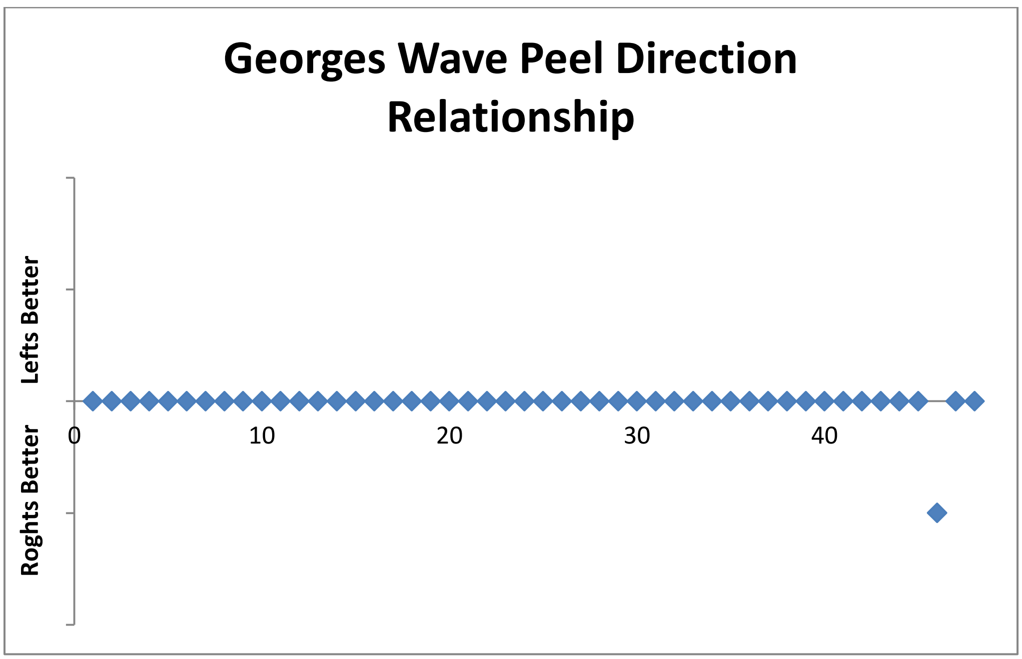
GEORGES



Georges		
	Lefts	Rights
Takeoff locations	Many peaks	Many peaks
Wave Breaking Speed	Fast	Fast
Breaker Type	Steep/hollow punchy	Steep/hollow punchy
Approx. Max. Ride Length (ft)	150 ft	150 ft
Best Tide	Mid to high	Mid to high
Approx. Max. Ride Time (sec)	5 to 10 sec	5 to 10 sec

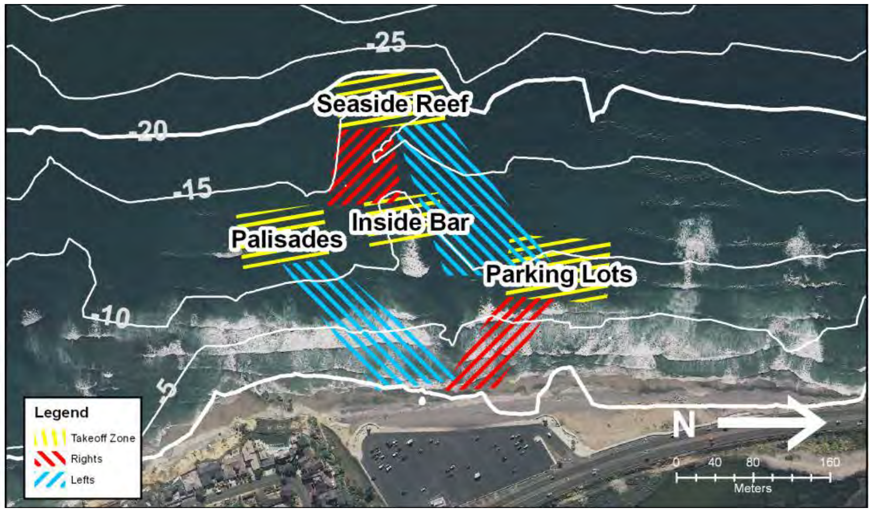
Georges is a long stretch of beach break with scattered peaks. On small days the majority of the swell energy misses Georges because of refraction and defocusing of the swell energy by Seaside Reef and Cardiff Reef. The waves at Georges tend to be a few feet smaller. On larger days this effect is not noticeable and with larger wind swells and combo swells the stretch can produce larger than average fast high performance left and rights. At low tides Georges is often plagued with waves that are too fast or closed out to surf. The reach is not protected by kelp, so afternoon sea breezes can be problematic. Mid to high tides and a mix of swells in the water produce the best waves a Georges. It is also popular during cleaned-up storm surf days during the winter. Surfer usage of this stretch is highly variable due to the nature of the changing condition of the beach break and its dependence on the lineup of tides, weather, and swell conditions. On a good day upwards of 20 advanced and professional surfers can be found in the lineup but it is also common to find the stretch of beach empty when less than ideal conditions.





Both lefts and rights usually break with equal surfability at Georges. A brief txt discription of the graph will also be very informative. The graphs for Seaside, Swamiis, and others show that at some of th ebreaks there is a better direction for catching waves (rights are better at swamiis, lefts are better at seaside, etc.).

SEASIDE



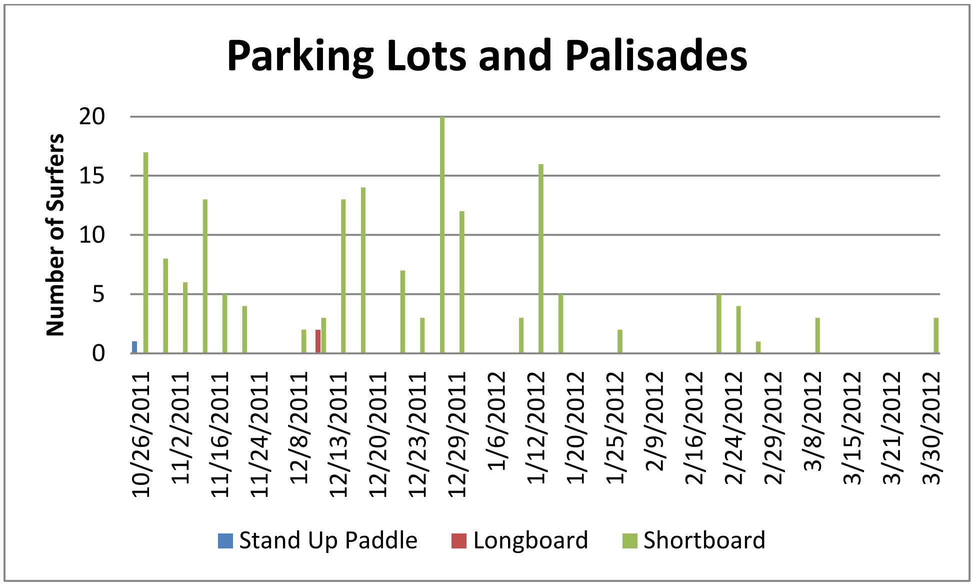
Inside Seaside		
	Palisades Left	Parking Lots Right
Takeoff locations	1	1
Wave Breaking Speed	Fast	fast
Breaker Type	Spread/peaky Punchy steep	Spread/peaky Punchy steep
Approx. Max. Ride Length (ft)	150 ft	150 ft
Best Tide	Any	Any
Approx. Max. Ride Time (sec)	5 to 10 sec	5 to 10 sec

Parking Lots:

Parking lots is the inside beach break located just north and on the inside of Seaside Reef. Smaller (generally less than six-foot) lefts and mostly rights. Typically best and highly surfed during small, short-period swell when Seaside Reef is not breaking.

Palisades:

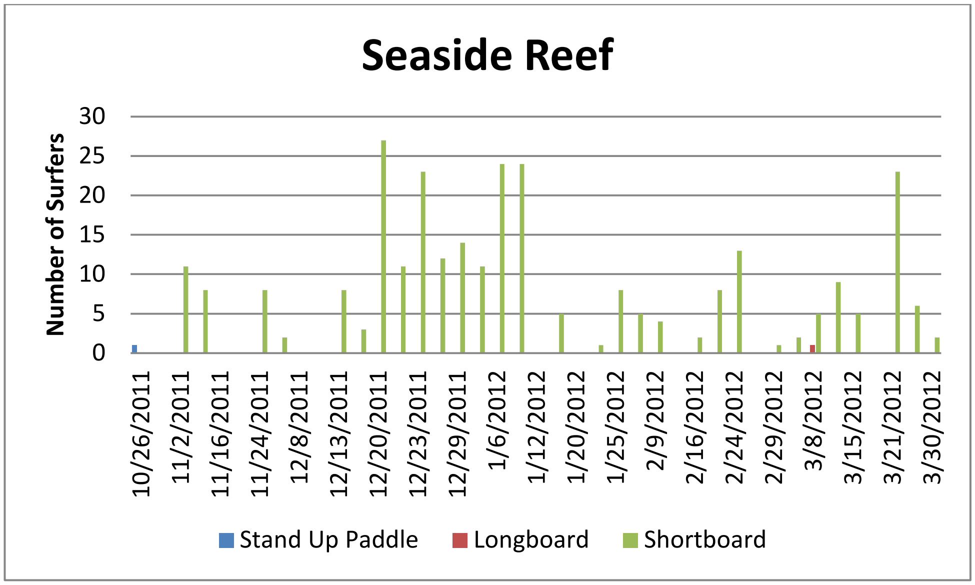
Located just south and to the inside of Seaside Reef. This wave breaks best on smaller swells when Seaside Reef is not working. This wave is a left that peels to the beach offering ramps, corners, and racy lines. Typically best and highly surfed during small, short-period swell when Seaside Reef is not breaking. On small days this is the high performance short board wave of choice within the study area.

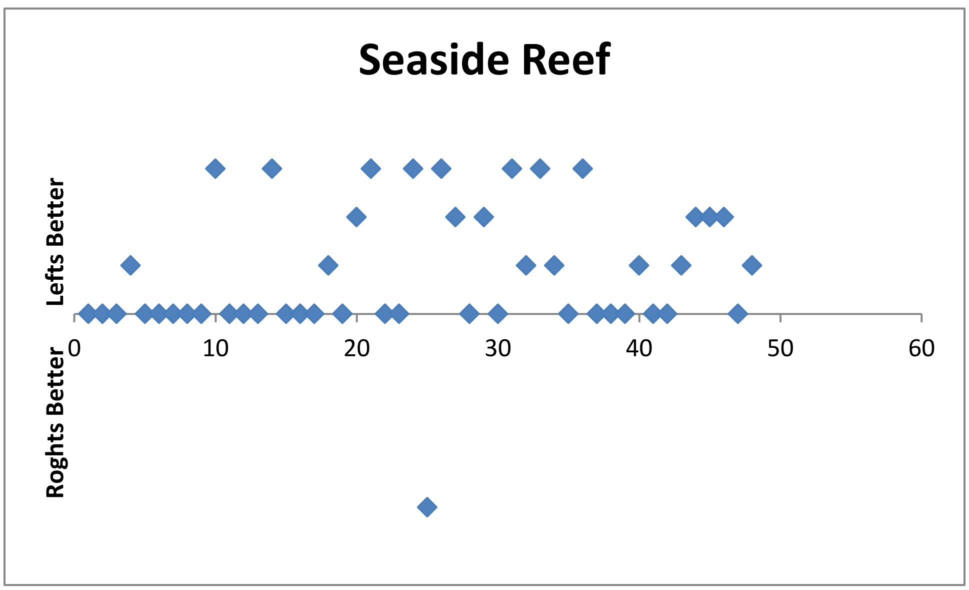


Seaside Reef:

Seaside Reef		
	Left	Right
Takeoff locations	1, tight	1, tight
Wave Breaking Speed	Fast	Slow
Breaker Type	Punchy/powerful Steep/hollow peeling	Weak/punchy Mushy/steep Small shoulder
Approx. Max. Ride Length (ft)	1000 ft	500 ft
Best Tide	Low to mid	Low to mid
Approx. Max. Ride Time (sec)	15 to 20 sec	5 to 10 sec

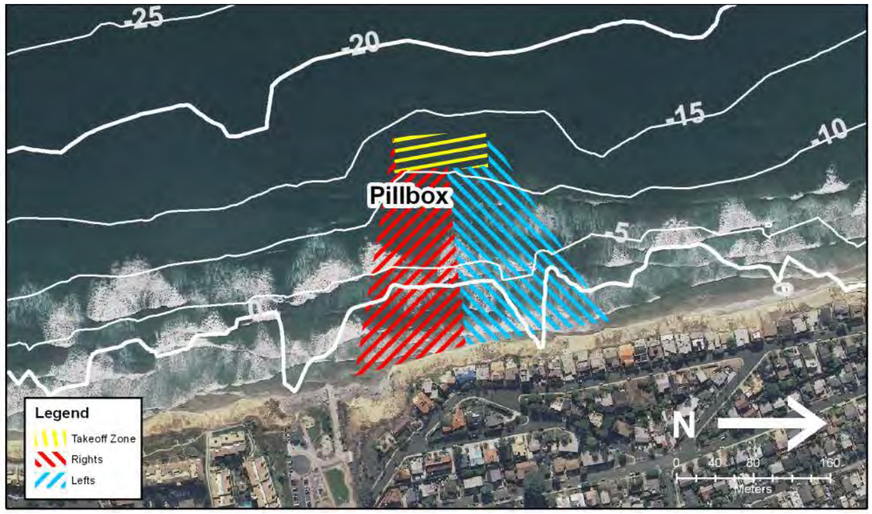
Seaside Reef is an offshore, shallow reef feature that creates a fairly long right and left-hand wave. The left is more consistent, longer, and is normally a better wave. Works during both SW and NW swells and is generally flat between swell events. The wave breaks abruptly over a shallow reef offering hollow waves at times. The left ranges from an excellent slow open shouldered peeling wave to an excellent fast steep hollow and lined up wave depending on the swell and tide. In good conditions the wave breaks about halfway to shore before fading in the deep area inside of the reef. In excellent conditions the left continues all that way through to the shoreline. The right has a similar steep punchy take off as the left but most waves on excellent days and all waves on normal days abruptly weaken with the deepening bottom and offer a very short take off followed by a slower no-shouldered whitewash ride. The vast majority of surfers surf left at the outside and the left is the best high performance left within the study area. This wave is consistently surfed by top professional surfers form around the globe when it is working. To surfers, Seaside Reef, Parking Lots, and Palisades are all casually collectively referred to as “Seaside”.





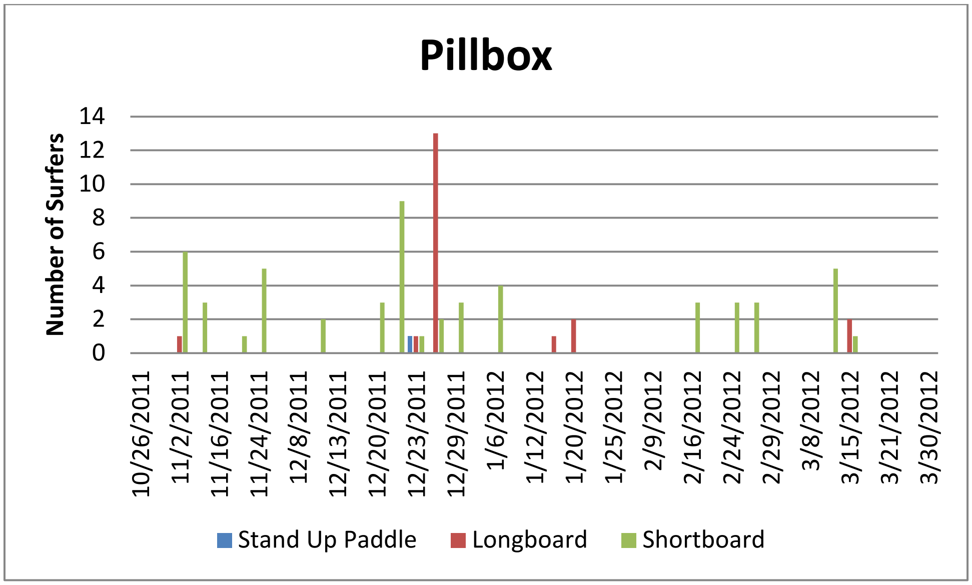
SOLANA BEACH REACH

PILLBOX



Pillbox		
	Left	Right
Takeoff locations	1	1
Wave Breaking Speed		
Breaker Type	Weak/punchy Mushy/steep Sectioning/walled	Weak/punchy Mushy/steep Sectioning/walled
Approx. Max. Ride Length (ft)	300 ft	300 ft
Best Tide	Low to mid	Low to mid
Approx. Max. Ride Time (sec)	10 to 15 sec	10 to 15 sec

At the north end of Fletcher Cove is a reef that produces a steep peeling left that ends in a closeout and a slower peeling right. This spot is known to locals as “pillbox”. Pillbox is generally flat and offers poor quality surf on high tides and smaller swells. Wave breaks on a fairly shallow, offshore reef feature that then connects to an inside beach break section. Dependent on swell direction, the wave can have longer and better lefts or rights. The wave is sensitive to changes in sand and also tide. Tides greater than three feet cause waves to reflect off of the bluff, which results in backwash and unsurfable conditions. The wave yields moderate crowds when conditions are right due to its form and central location. Compared to the others waves within the Solana Beach Reach, Pillbox is less heavily surfed than Seaside and Tabletops but more heavily surfed than Cherry Hill. Parking is easier than at Cherry Hill. Pillbox is the best at lower tides when the waves are in the waist to head high range. Bigger than head high and the reefs start to close out and smaller than waist high and a longboard is needed to catch waves. When it is working Pillbox produces fun quality lefts and rights that are very surfable. It is a fickle wave and hard to tell when it will be good or not. Pillbox can be a fun less crowded alternative to the other heavily impacted surf sites of Cardiff and Solana beach.

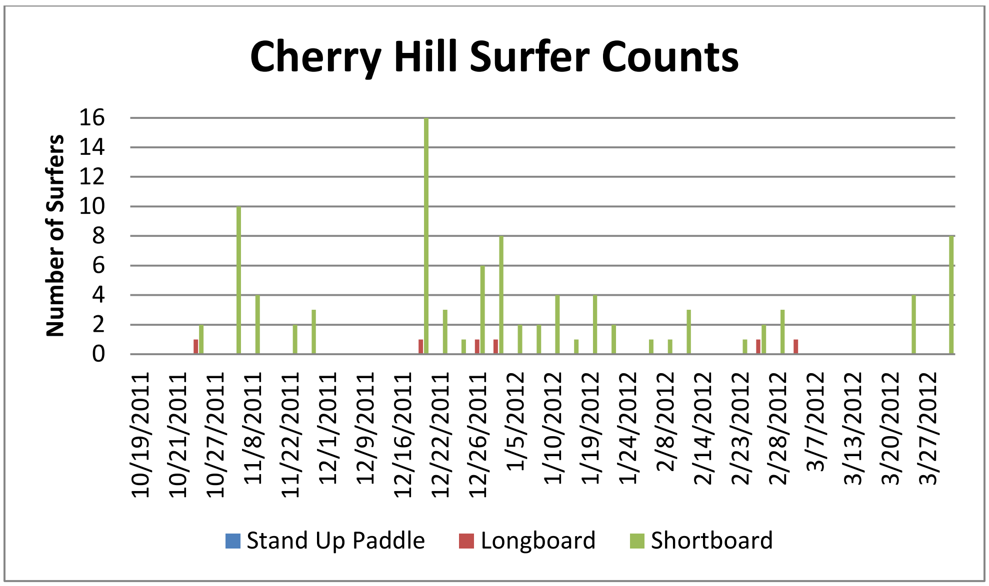


CHERRY HILL

Cherry Hill		
	Left	Right
Takeoff locations	peaky	peaky
Wave Breaking Speed	Fast	Fast
Breaker Type	Weak/punchy Mushy/steep Sectioning/walled	Weak/punchy Mushy/steep Sectioning/walled
Approx. Max. Ride Length (ft)	300 ft	300 ft
Best Tide	Low to mid	Low to mid
Approx. Max. Ride Time (sec)	10 sec	10 sec

The rights and lefts at Cherry Hill have peaky takeoffs, are usually weak to punchy, mushy to steep, sectioning, walled, or small shouldered waves. Most of the waves breaking are of lesser quality than these best waves and the best waves that the surfers wait for come in inconsistently, are of variable breaking speed and are surfed for up to 10 seconds and a few hundred feet.

Cherry Hill is a beach break with short scattered right and left-hand waves typical of an average standard southern California beach break. This is one of the least surfed waves within the study reach. To its benefit, surfers generally have a less crowded surfing experience at this wave and rarely were there more than a few surfers out at any one time. Competition for waves is minimal at this site. On the negative, this spot becomes severely impacted and unsurfable at higher tides. This spot shuts off on any tides higher than a mid-tide. Another possible reason for the infrequent use of this beach despite wave quality is the difficult beach access compared to the other spots in the study. To access the spot one must find limited parking space and walk along a path for 300m to check the surf and then return to their car suit up and walk back to the beach to surf. Public Parking is limited to a handful of on street parking spots that have competitive use from the residential communities and commercial retail park across the street. These conditions make this spot require the most effort to check conditions at and surf compared to the other study locations which do not require the beach user to leave their car to see the wave conditions. Given that the wave is no better than any of the other spots, this is part of the reason as to why it see less usage than other waves within the reach. There are specific beach user groups for this site. The stairs descending to the beach at Cherry Hill are heavily used by community members for workouts and physical activity. At high tides the beach is non-existent and covered up by the ocean water and attempting to walk along the beach to other access points is very dangerous. No other access points are connected to Cherry Hill by dry sand at high tides.



Waves within reach that data was not collected for

Tabletops: Left and right-hand reef break that breaks offshore. Multiple short rights breaks off of the far southern fringes of the reef with punchy left sections on smaller days and a singular right with hollow sections during large swells. The right is generally uncrowded compared to the left. A longer peeling left breaks in the central portion. Works during both SW and NW swells but is generally considered best during SW swells. One of the best spots in North County during a large SW swell. The left can be long and connect to the outside of Palisades. Table tops can hold swells as large as Swami's but with a smaller crowd factor. On smaller days the wave offers fun longboarding rides and an uncrowded surfing experience rare for this region of the coast.

Fletcher Cove: Left and right-hand beach break just south of Pillbox. This is a standard beach break whose conditions are highly dependent on tide and sand conditions.

Rockpile: Left and right A-frame reef break. Wave breaks offshore and breaks slowly in both directions. Allows for few maneuvers and is popular with longboards because of its slow nature. The inside section can be faster and is surfed by shortboards.

APPENDIX B:
SURFING MONITORING DATA SHEET

FINAL

SELRP
SURFING MONITORING PROGRAM

TIM STILLINGER
SELC ASSOCIATE BIOLOGIST

OBSERVER **STATION ID** **TIME (24Hr)** **Date**

WIND SPEED/SEASTATE (Beaufort Scale)
OFFSHORE 0 1 2 3 4 5 6 7 8 9 10
INSHORE 0 1 2 3 4 5 6 7 8 9 10
WIND DIRECTION
ONSHORE OFFSHORE CALM

Surfer Count
SUP | LB | SB | BB | BS

LONGSHORE CURRENT yes / no
DIRECTION north / south
STRENGTH S1/ S2/S3/S4/S5

Peak 1 ______________
 # OF SURFERS ________
PEEL DIRECTION R L R/L

Peak 2 ______________
 # OF SURFERS ________
PEEL DIRECTION R L R/L

WAVE DIRECTION (RELATIVE TO SHORE)
L SL N SR R

	LEFTS	**RIGHTS**
WAVE HEIGHT (FT)		
SURFABILITY		
WAVE TYPE	Short / Long / Mixed | Mushy / Steep / Hollow Slow / Fast | Tight / Spread / Peaky / Shifty NoSho/ SmlSho / P-ling / Sect / Walled / Closed Weak / Punchy / Powerful Con. / Incon. / Very Incon. / Flat	Short / Long / Mixed | Mushy / Steep / Hollo Slow / Fast | Tight / Spread / Peaky / Shift NoSho/ SmlSho / P-ling / Sect / Walled / Closed Weak / Punchy / Powerful Con. / Incon. / Very Incon. / Flat
% Unsurfable	0 / 1-20 / 21-79 / 80-99 / 100	0 / 1-20 / 21-79 / 80-99 / 100
RIDE LENGTH (FT)	0 / 1-99 / 99-300 / 301-900 / >900	0 / 1-99 / 99-300 / 301-900 / >900
RIDE TIME (sec)	0 / 1-5 / 6-10 / 11-15 16-20 / 21-25 / 26-30 / >30	0 / 1-5 / 6-10 / 11-15 16-20 / 21-25 / 26-30 / >30
COMMENTS:		

OBSERVER **STATION ID** **TIME (24Hr)** **Date**

WIND SPEED/SEASTATE (Beaufort Scale)
OFFSHORE 0 1 2 3 4 5 6 7 8 9 10
INSHORE 0 1 2 3 4 5 6 7 8 9 10
WIND DIRECTION
ONSHORE OFFSHORE CALM

Surfer Count
SUP | LB | SB | BB | BS

LONGSHORE CURRENT yes / no
DIRECTION north / south
STRENGTH S1/ S2/S3/S4/S5

Peak 1 ______________
 # OF SURFERS ________
PEEL DIRECTION R L R/L

Peak 2 ______________
 # OF SURFERS ________
PEEL DIRECTION R L R/L

WAVE DIRECTION (RELATIVE TO SHORE)
L SL N SR R

	LEFTS	**RIGHTS**
WAVE HEIGHT (FT)		
SURFABILITY		
WAVE TYPE	Short / Long / Mixed | Mushy / Steep / Hollow Slow / Fast | Tight / Spread / Peaky / Shifty NoSho/ SmlSho / P-ling / Sect / Walled / Closed Weak / Punchy / Powerful Con. / Incon. / Very Incon. / Flat	Short / Long / Mixed | Mushy / Steep / Hollo Slow / Fast | Tight / Spread / Peaky / Shift NoSho/ SmlSho / P-ling / Sect / Walled / Closed Weak / Punchy / Powerful Con. / Incon. / Very Incon. / Flat
% Unsurfable	0 / 1-20 / 21-79 / 80-99 / 100	0 / 1-20 / 21-79 / 80-99 / 100
RIDE LENGTH (FT)	0 / 1-99 / 99-300 / 301-900 / >900	0 / 1-99 / 99-300 / 301-900 / >900
RIDE TIME (sec)	0 / 1-5 / 6-10 / 11-15 16-20 / 21-25 / 26-30 / >30	0 / 1-5 / 6-10 / 11-15 16-20 / 21-25 / 26-30 / >30
COMMENTS:		

APPENDIX C:
PUBLIC SURVEYS

San Elijo Lagoon Restoration Project

Surfing Survey

Survey Location: ________________________ Name (Optional): ___________________________

Survey Time: ___________________________ Contact (Optional): __________________________

City of Residence: _______________________ Email (Optional): ___________________________

1) Sex: (M/F)
2) Age:
   a) <14
   b) 15-24
   c) 25-34
   d) 35-44
   e) >45
3) Primary Surfboard type:
   a) Longboard
   b) Shortboard
   c) Stand-up paddle-board
   d) Other (kneeboard, bodyboard)
4) Years of surfing:
   a) <5
   b) 5-10
   c) 10-15
   d) 15 – 20
   e) >20
5) Years of surfing this spot or in the vicinity of this spot (within 2 miles)?
   a) < 5
   b) 5-10
   c) 10-15
   d) 15-20
   e) > 20
6) How often do you surf here?
   a) < 100 days / year
   b) 100-150 days / year
   c) 150-250 days / year
   d) >250 days / year
7) What season(s) do you normally surf here?
   a) Winter
   b) Spring
   c) Summer
   d) Fall
8) What time do you typically surf here?
   a) Before 10 am
   b) 10 am to 12 pm
   c) 1 pm to 5 pm
   d) After 5 pm
   e) Whenever it's best
9) What tide to you typically surf here?
   a) low (< 1.5 ft)
   b) Mid (1.5 - 3 ft)
   c) High (> 3 ft)
   d) Whenever it's best
10) Why do you like to surf here?
   a) Wave Quality
   b) Consistency
   c) Convenience
   d) People / environment

11) What types of wave do you prefer? Please pick your favorite from each column.

Break Type	Shape	Size(ft)	Direction	Swell	Face	Power
Reef Break	Hollow	1-3	Lefts	Wind Swell	Peeling	Weak
Point Break	Steep	3-4	Rights	GroundSwell	Sectioning	Punchy
Beach Break	Mushy	4-6	Both	ComboSwell	Corners	Powerful
		6-8		Anything	Closed out	
		8+				